RUTGERS
CUES — Center for Urban Environmental Sustainability

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EXECUTIVE SUMMARY

Based on our 2018 inventory and assessment of the Drumthwacket Estate, the official residence of the governor of New Jersey, this report outlines specific action items that will improve plantings following historic preservation and ecological development goals, introduce sustainable storm-water management and increase educational opportunities.

A long term management and maintenance plan will ensure that Drumthwacket Gardens will function as a welcoming meeting place for New Jersey residents and as a model of public estate management.

Figure 1 - Four photos of the Drumthwacket Estate Italianate Garden. Images by Giovanni Caputo.

INTRODUCTION

Drumthwacket Estate, the official residence of the governor of New Jersey, has the potential to serve as a home, welcoming meeting place, and model of public estate management. This report outlines a strategy to inventory and plan for the restoration of the estate's grounds, with the goal to preserve its historic significance, enhance public engagement in its upkeep, increase education opportunities, and incorporate best practices for sustainable storm-water management and habitat diversity.

The estate is currently managed by the Drumthwacket Foundation and the NJ Department of Environmental Protection (Director's Office, Gen Svcs & Support Svcs). The New Jersey Master Gardeners Program has a role in maintaining selected plantings and provides seasonal decorations. According to the Chief of Staff to the First Lady and the Resident Director at Drumthwacket, the current conditions of the Drumthwacket landscape do not meet current and anticipated needs. Some of the historic garden elements are in disrepair, storm water management is not up to current sustainability standards, and the visual appearance of the landscape falls short of the expressed expectations.

In summer 2018, a team of the Rutgers Center for Urban Environmental Sustainability developed a detailed Inventory, Assessment and Immediate Action Plan in close partnership with the Drumthwacket Foundation. That document illustrates that Drumthwacket has a unique opportunity to set an example of a sustainably managed and designed grounds for large estates in New Jersey. With the first complete site plan in recent history, storm-water analysis, and planting bed inventory, it is now possible to build upon the past improvements and designs to exemplify the State's sustainable design goals.

During fall semester 2018, the class "Suburbia Transformed" led by Prof. Holly Nelson in the Landscape Architecture Department at Rutgers University developed a collection of landscape designs for a more sustainable Drumthwacket. The task of this studio was not to provide engineered solutions, but rather to create different conceptual suggestions for showcasing sustainable landscapes that can be integrated into a future design. The designs represented different ways to achieve sustainability, ranging from more ecological suggestions (increased woodland coverage or using the site to promote options for mowed lawn to promote plant diversity and lowered chemical usage) to incorporating technology (solar energy, ergonomic energy), improving storm-water management, creating wildlife habitat, and expanding plant diversity.

This report builds on both, the thorough inventory and analysis from summer 2018 and the free spirited design explorations, to develop pragmatic short-term solutions and long term management suggestion.

A NEW VISION FOR THE GOVERNOR'S MANSION

Storm-Water Management System

The storm-water assessment prepared in the *Drumthwacket Garden Inventory, Assessment, and Immediate Action Plan*, showed a need for an updated storm-water management system at the Drumthwacket estate. Currently, most runoff is being directed towards the lower southeastern corner of the property into the retention pond where it is stored. The creek that runs through the forested area on the bottom edge of the property effectively allows water runoff from the parking lot and garden to flow through the creek bed and into the pond. However, there should be more opportunities on the property for storm-water runoff to percolate back into the soil as it moves towards the retention pond. Therefore, we are proposing a rain garden to be added in at the front of the property to catch runoff coming directly off the roof of the Governor's Mansion via the existing downspouts.

This rain garden will function in four parts (as seen in Figure 2.1), as follows: the existing downspouts will be modified to allow storm-water to exit out onto splash blocks, the splash blocks will then connect to exposed concrete channels that will enable the water to be seen from above, from there the water will enter into a trough on the outer edge of the rain garden bed to allow even dispersion across the rain garden, finally the water will percolate through the rain garden and exit out via a drainage pipe that connects back to the existing downspout.

The design of the rain garden will remain in line with the formal aesthetic of Drumthwacket, while also bringing in modern elements of storm-water management. The rain garden will measure 50′ by 6′ with a total area of 300 square feet to accommodate the volume of water that will be coming out of the three downspouts that feed into the garden. The basin will be 9″ deep and filled with Delaware river stone at 3-5″ large to allow the water enough room to percolate around the rocks. The outer edge of the rain garden will be a 6″ wide concrete curb to keep the design formal and the area well defined. Our recommendations for vegetation in the rain garden are Cinnamon Fern, Blue flag Iris, and Pennsylvania Sedge based upon their water-loving properties and ability to survive in occasionally drier conditions. Keeping the plant palette simple will ensure the overall appearance of the rain garden will not take away from the impact of the mansion's facade.

Overall, the rain garden will add an element of education on residential rain garden designs. The exposed channels will ensure that visitors can visualize how the water travels from the downspouts, into the trough, and percolate into the rain garden. With the assistance of signage, the importance of storm-water management systems can be explained to visitors and possibly encourage them to create a rain garden in their backyards!

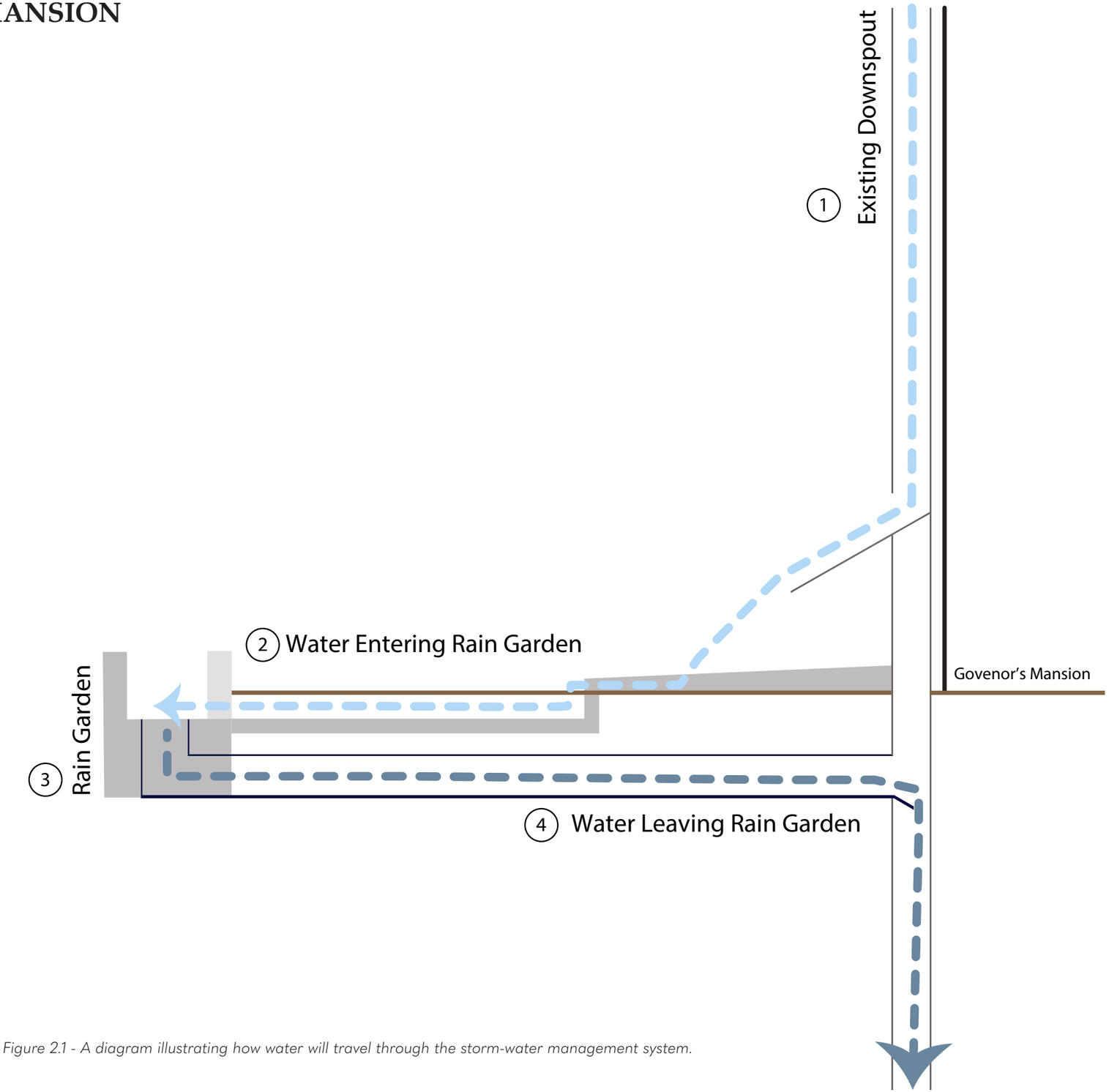
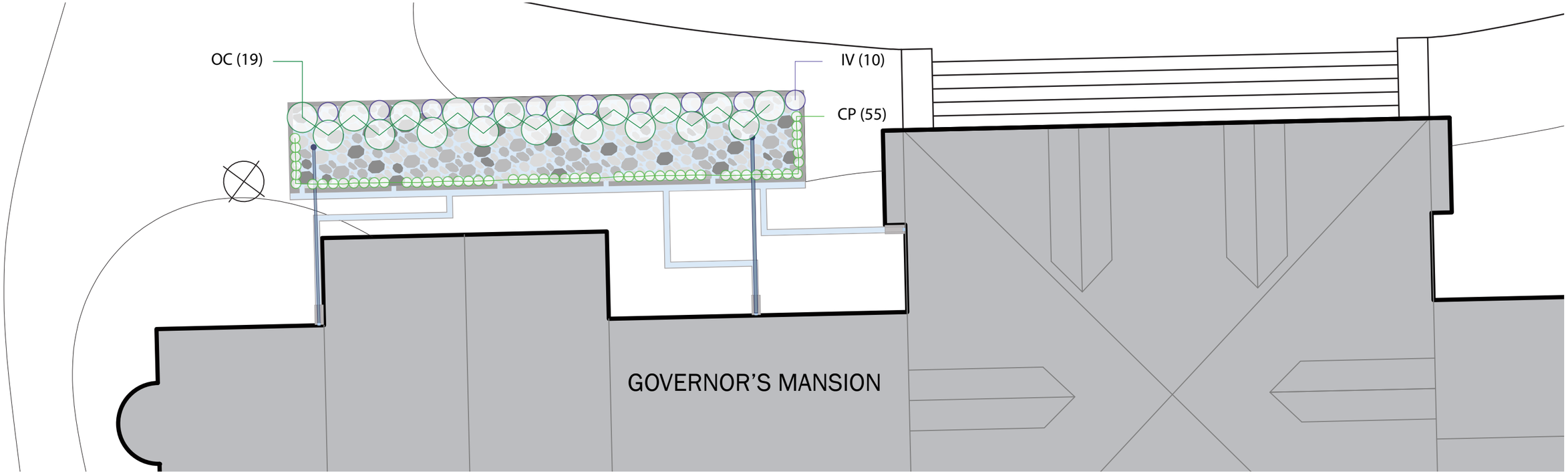


Figure 2.1 - A diagram illustrating how water will travel through the storm-water management system.



OC *Osmunda cinnamomea*
Cinnamon Fern [1]

IV *Iris versicolor*
Blueflag Iris [1]

CP *Carex pensylvanica*
Pennsylvania Sedge [1]

Figure 2.2 - (above) Planting plan and general construction of the rain garden.

Figure 2.3 - (left) A perspective of the rain garden in front of the Governor's mansion.

Figure 2.4 - Example of a perennial meadow next to a mowed lawn. Image by Larry Weaner Landscape Associates.

Establishing A Meadow

Creating a meadow at Drumthwacket would be a great opportunity to help set an example for residents of New Jersey on the importance of sustainable landscape design. There are many factors that go into the success of a meadow, but it all starts with the right conditions to start growing. To ensure that no unwanted species colonize the meadow all existing vegetation must be removed by covering the proposed area in a dark material, such as plastic sheeting, over the course of a summer. Come fall the area will be ready to accept the new plants starting with the dispersal of seeds over the area while using a rake to make sure they are covered with soil. It is better to overestimate the amount of seed needed to accommodate for any seeds that fail to germinate. Once the meadow is fully established, the required maintenance for the area will consist of annual mowing in the winter before the growing season starts in the spring. This meadow will not only provide food and habitat for a variety of species, but also additional color and texture to the Drumthwacket property.

In Figure 2.5, we have marked out potential areas where a meadow could be established. Using the criteria we were able to find which areas were most suitable by calculating how many optimal conditions were present at each site. Based on our judgment with the criteria, we determined that the test area located on the southwestern end of the property would be ideal for establishing a meadow at Drumthwacket. This area receives the most sunlight, it is at the top of a gentle slope preventing water from settling, and it does not detract from the visitor's first impression of the Drumthwacket estate. A path could be added in to allow visitors to walk through it on their way down to the pond or over to the new soccer field.

The meadow will function as another educational aspect of Drumthwacket to inform visitors on the benefits of meadows and how it could be implemented in residential garden design. By being able to see how a meadow looks in a formal setting, such as the Governor's Mansion, visitors may feel encouraged to establish one of their own!

Key

More Suitable Location

Less Suitable Location

Criteria

1. Meadows prefer to receive high amount of sunlight throughout the day.
2. Meadows perform best on a gentle slope.
3. Meadows should be located in dry areas to prevent wet tolerant plants from colonizing.
4. Good air movement through the meadow is essential to keeping diseases at bay.
5. Meadow allows the mansion to remain the focal point for visitor's first impression of the estate.

Suitable Locations for Meadow Test Areas

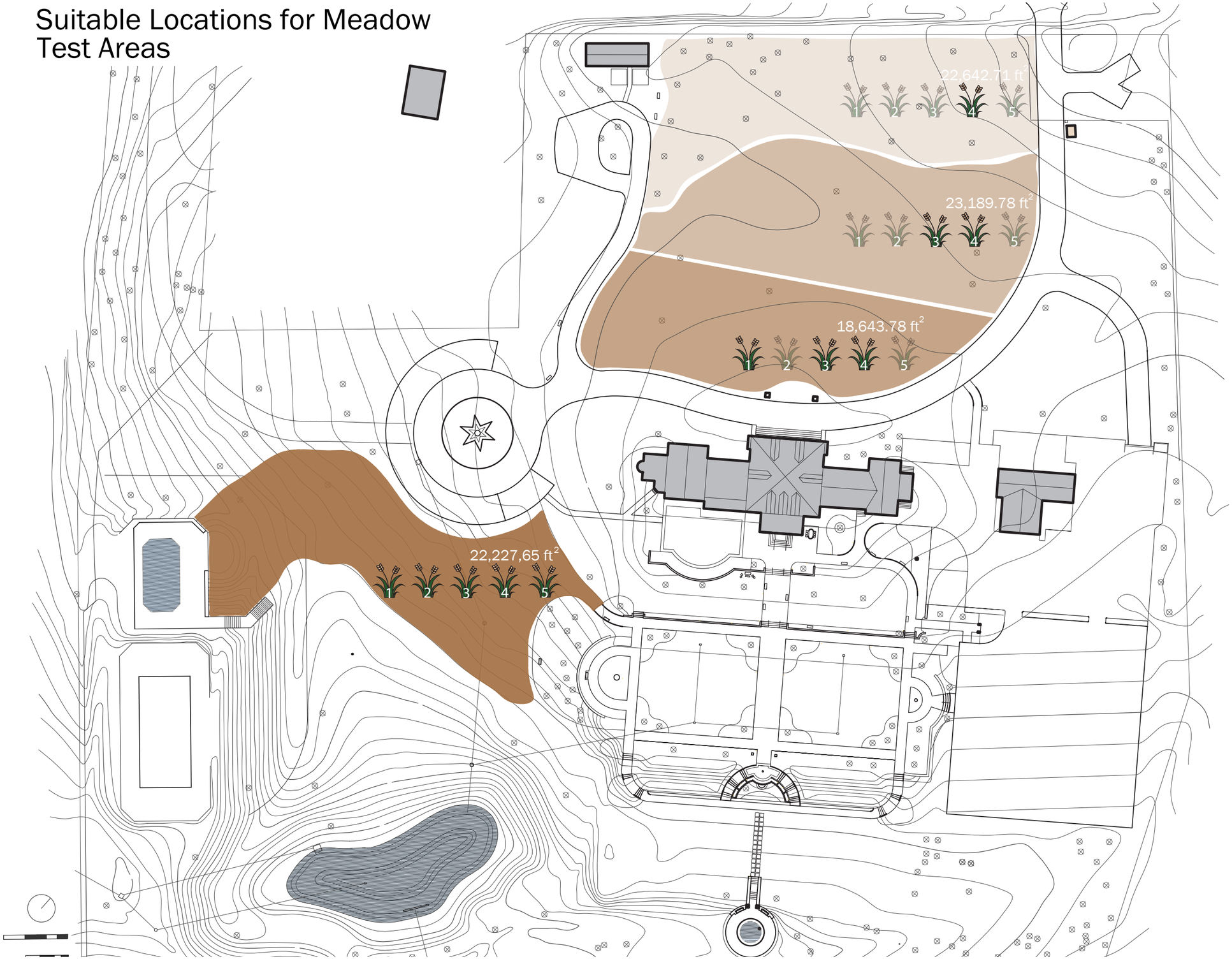


Figure 2.5 - Map of suitable locations for a meadow at Drumthwacket.

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Incorporating the Garden State Parkway Wildflower Mix

Introducing the Garden State Parkway wildflower seed mix at selected locations along the parkway is one of the many programs in place that are working to beautify New Jersey. Further, this program helps to reduce mowing costs and increases habitat diversity. It is a rather simple and low cost approach to reduce lawn areas that may also be successful for residential areas and office parks. Although it may not provide the same habitat quality of an established meadow, adding the seed mix to existing grass areas is much less effort than installing a meadow.

The Garden State Parkway seed mix is readily available to the general public. By featuring the mix at the Drumthwacket entrance, visitors will be introduced to this simple approach to install wildflowers and may be inspired to do the same in their yards. The seed mix is a combination of Yellow Cosmos, Plains Coreopsis, and Mixed Cosmos which will bloom in late spring/early summer. We are suggesting to supplement with spring bulbs to add within the mix to add in more flowers. The flowers within the seed mix can survive in several growing conditions making it scalable for residential gardens. Figure 2.8 shows the recommended locations where the flower mix can be planted at Drumthwacket. All of the proposed areas are near vehicular access points, which mirrors where the mix is currently being used on the Garden State Parkway. Adding in the flower mix on the perimeter of the Drumthwacket can add a charming aesthetic to the fencing on the edge of the property as visitors drive to the parking lot.

Figure 2.6 - Photo of Garden State Parkway Wildflower mix along a section of the Parkway. Image by Patch.
Figure 2.7 - Garden State Parkway logo. Image by Ocean Happening.

Potential Planting Areas for Garden State Parkway Wildflower Mix

Figure 2.8 - Map of potential planting areas for Garden State Parkway Wildflower seed mix.

Bringing Bees onto Drumthwacket

Figure 2.9 - Example of traditional beehive box. Image by North creek Nurseries.

Figure 2.10 - Example of a Mason Bee hive mounted in a tree. Image by Gardener's Supply Company.

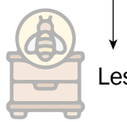
When discussing the benefits of diverse plantings, such as the proposed GSP Wildflowers and perennial meadow planting area, one of the most exciting features will be the food sources that these plants will provide for pollinators. With one of the most well-known and currently endangered pollinators being the bee, we propose the addition of a beehive on the property to help promote the importance of pollinators in New Jersey. Having a beehive at Drumthwacket would provide an excellent opportunity to educate visitors on why bees are endangered, why they are so important to our ecosystem, and how they can help rebuild the population of bees locally. To help keep the hive healthy and happy, Drumthwacket can partner with local beekeeping groups that could help to maintain the hive and harvest honey when necessary. Drumthwacket could potentially, in turn, sell this honey or give it as a gift at government-run events to help promote the sustainable practices they have employed on-site. Alternatively, Drumthwacket could provide a habitat for bees without the presence of a permanent hive. Mason Bees are a type of bee that does not need a colony to survive; they would be able to live in the structure shown in Figure 2.10 that could easily be mounted in trees around the property. This option would be less maintenance than the beehive while still providing an educational aspect for visitors on the importance of bees.

To help illustrate the potential areas where a beehive could thrive, we created the following criteria to help determine the most suitable areas for a colony. The hive must not be bothered by human interference, but close enough to pathways that the hive could be visible for educational purposes and easily accessed for maintenance. Beehives need help warming up in the morning, so exposure to morning light is the key to waking up the hive, but too much direct sunlight could cause the hive to overheat therefore afternoon shade would be essential to its health. Shelter from harsh cold wind would help the hive retain heat in the winter so shelter from the north would aid protecting the hive. A potential hazard to beehives is the infestation of the Hive Beetle which thrives in moist conditions. These pests can be extraordinarily harmful to hives, so to combat this we suggest the hive be placed in a dry area with a gravel base underneath and elevated at least 10-18" off the ground to help keep pests from moving up through the soil.

The considerations were translated into criteria for identifying and assessing potential sites on the property. Figure 2.11 shows the areas most suitable and least suitable for a beehive. The area we found that best fits the needs of a hive would be along the northern side of the security booth. This area is removed enough from human activity to minimize interference, but close enough for visitors to see from their cars as they enter the property. Although bees can fly up to four miles from their hive for food, the location of the hive would align with the GSP Wildflower planting area which provides a convenient food source for the bees. The presence of a beehive at Drumthwacket could potentially help visitors learn more about how important bees are to our world and break down some stereotypes that people hold about bees.

Key

More Suitable Location



Less Suitable Location

Criteria

- The hive is located away from heavy foot traffic to avoid human interference.
- The hive receives a lot of morning sun so the bees will rise & warm up quickly in the morning.
- The hive receives partial shade in the afternoon to shield the hive from intense heat.
- The hive has shelter from northern winds to keep the hive warm in the winter.
- The hive is located near a dry and warm area to avoid the infestation of hive beetles.

Suitable Bee Hive Locations

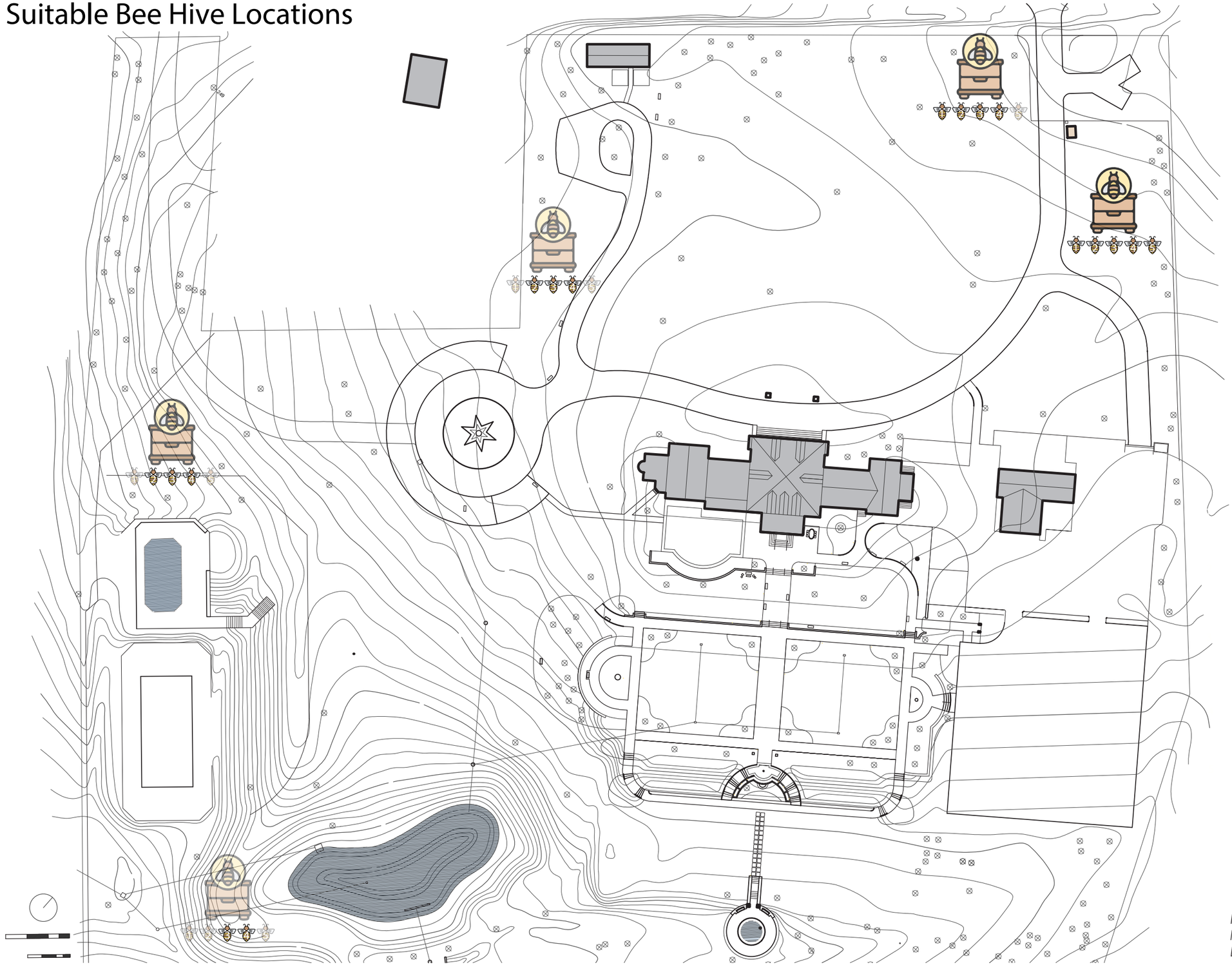


Figure 2.11 - Map of suitable locations for a beehive at Drumthwacket.

Figure 2.12 - Example of a caged compost pile. Image by Grow it Organically.

Figure 2.13 - Example of a three step compost bin. Image by Nancy on the Home Front.

Composting at Drumthwacket

The current "composting" area at Drumthwacket is located in an alcove at the bottom of a slope leading towards the retention pond. This area is used to store the wood-chip mulch that gardeners then use on planting beds in the spring and serves no other purpose beyond that. We are proposing for Drumthwacket to establish a new compost pile to be used for grass clippings and leaf waste that could later be applied around the property. The compost pile will be another point of education for sustainable home gardening practices. Informative signage will explain how composting works, which material is appropriate for composting and when the inclusion of food waste is suitable. Using the produced compost for mulching (instead of wood chips) and feeding of planting beds will further illustrate the benefits of composting. Having a compost pile on display at the Governor's Mansion visitors will be exposed to new sustainable practices that they were unaware of or were unsure if they could do it on a residential scale.

Figure 2.14 shows a map and criteria to find the most suitable location for a potential compost pile on the property. The compost pile would need to be in a well-drained area away from standing water to reduce the chance of mold establishing on the compost. The compost area will decompose well in warmer areas and sites located on top of the soil/ lawn where decomposer's have direct access to the decaying matter. We would not want the compost pile to be located too close to visitor activity in case of important events, but close enough for educational purposes and vehicular access for the gardeners. After site assessments following these criteria, we determined the area located to the west of the pool would be most suitable based upon the existing conditions of that area and its proximity to the road that will be opened up for vehicular traffic. By having the compost pile tucked into the western edge of the property, we invite visitors to explore the grounds, but also separates it from any events that may be taking place in the central garden.

Key

More Suitable Location

Less Suitable Location

Criteria

1. The compost pile is located on a level & well drained area to avoid the establishment of mold.
2. The compost pile has direct sunlight so that it can trap heat and break down the leaf material efficiently.
3. The compost pile is located on top of soil or lawn so earth worms can aid in the decomposition process.
4. The compost pile has enough of a visual barrier for guests to avoid unwanted contact, but close enough to be used for educational purposes.
5. The compost pile is protected from freezing winds that will hinder its decomposition process.
6. The gardeners can have easy vehicular access to the compost pile.

Suitable Compost Locations

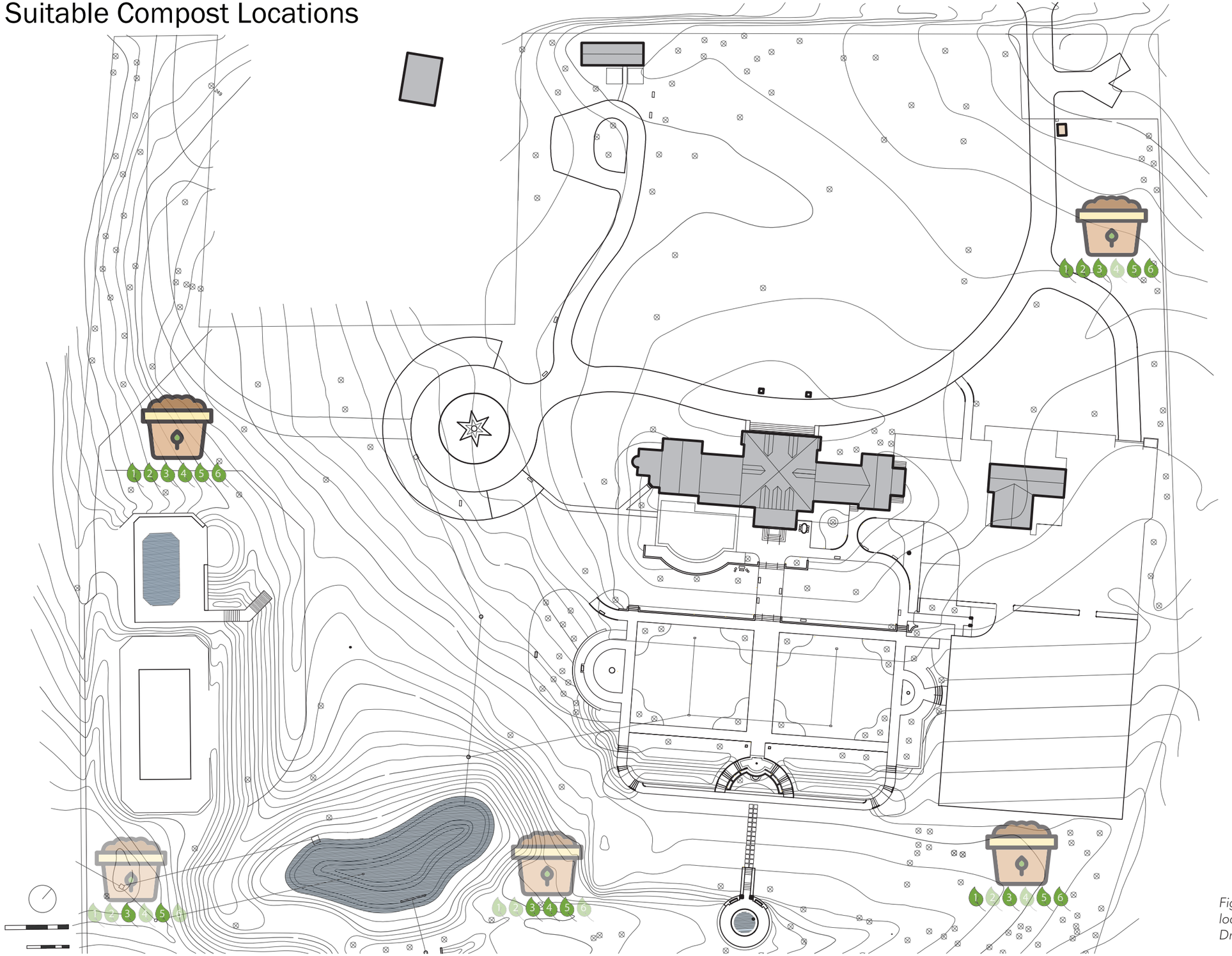


Figure 2.13 - Map of suitable locations for a compost pile at Drumthwacket.

BRINGING LIFE BACK INTO THE ITALIANATE GARDEN

The Italianate Garden is the heart of Drumthwacket. Daniel Webster Langton, one of the eleven founding members of the American Society of Landscape Architects, was hired in 1905 to design Drumthwacket's entire property including the Italianate Garden. That formal design element was a common feature in American estates of the early twentieth century, Langton utilized existing topography to establish a sequence of terraces with visual connections to the landscape. Our 2018 *Drumthwacket Garden Inventory, Assessment, and Immediate Action Plan*, includes a detailed time line of the gardens. Because of several changes in ownership and periods of neglect, the Italianate Garden deteriorated beyond repair and was replaced by an Italianate style reconstruction in 1992. Maintaining the spatial framework, heavily damaged balustrades and retaining walls were replaced by modern garden elements and new planting schemes were introduced. Our 2018 inventory showed that some plantings suffered from changing light conditions and low maintenance and need additions or replacements.

A detailed assessment of planting beds can be found on pages 15-17 of the 2018 inventory, pages 10-11 provide the key to the existing trees marked in the 2019 tree removal plan (Figure 3.1).

We propose to remove four trees, one shrub and partly remove one tree. The four River Birched (*Betula nigra*) along the bottom edge of the core terrace of the garden were originally planted to provide a spatial frame for the parterre. The fast-growing Birch served that purpose very well but has by now outgrown the scale of the garden. Because Birches do not react well to pruning, we propose to remove these trees and to replace them with Eastern Redbud (*Cercis canadensis*, see Figure 3.1).

The two of the three existing trunks of the Katsura (*Cercidiphyllum japonicum*) are in bad conditions and need to be removed.

To further open up that planting area, we propose to eliminate the current path that runs into the bed to simplify the entrance sequence to the side path and the main entrance from the parking lot. The next proposed removal would be of the Viburnum grandiflora, located in the lower right-hand corner of the core terrace garden. By removing the shrubs that are not currently thriving, we open up these corner beds and make room for new plants that will thrive in the current conditions of the garden. The last change we proposed was the removal of the four River Birch (*Betula nigra*) along the bottom edge of the core terrace of the garden. Since these trees were always meant to be temporary plantings, the removal of these overgrown River Birch's will allow more light to enter the garden by replacing them with more appropriately sized trees.

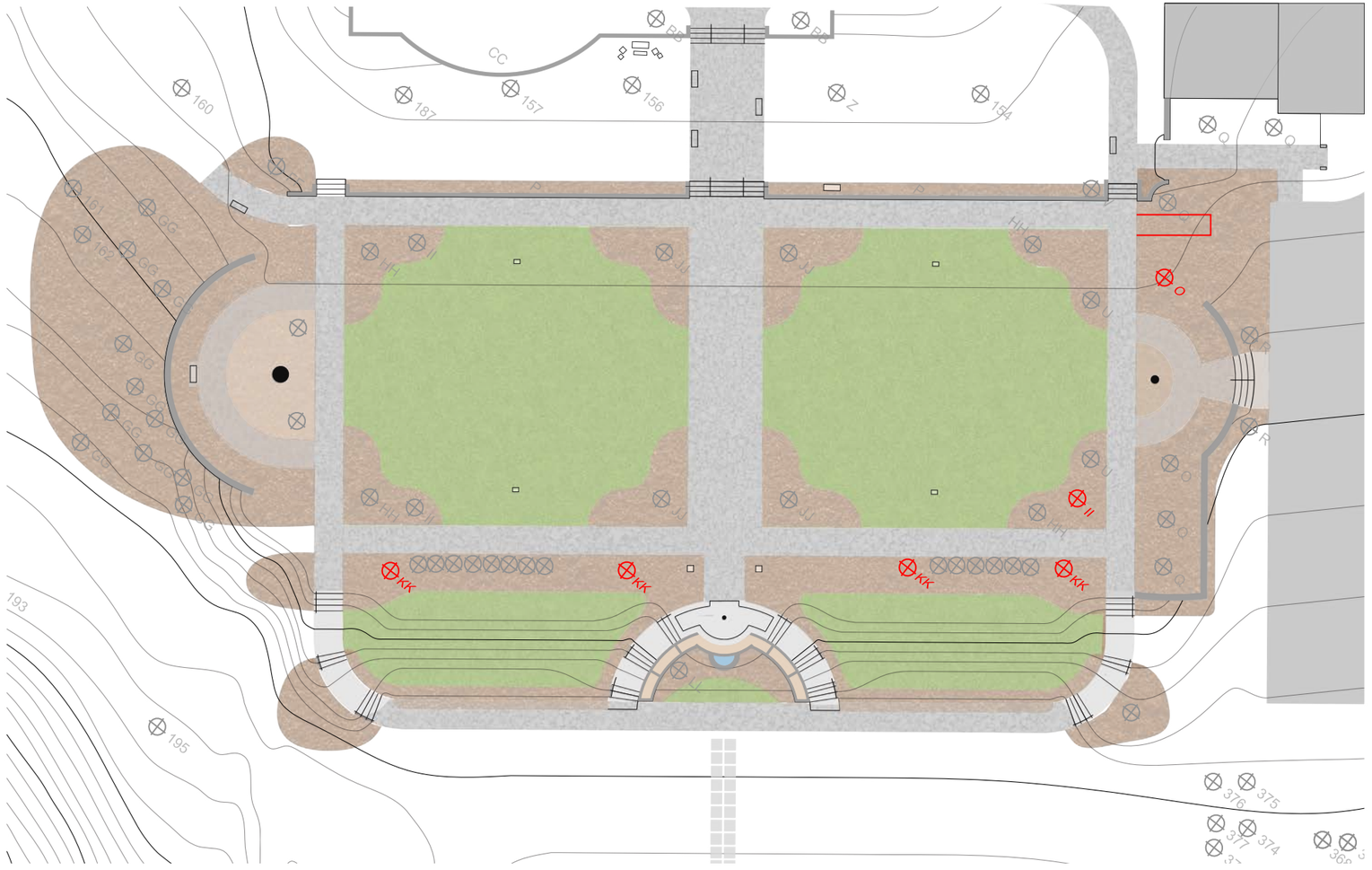


Figure 3.1 - Map illustrating the trees and shrubs to be removed from the Italianate Garden.

On the following page, we have illustrated the different areas of focus that we will concentrate on for improving with an upgraded planting palette. In the Italianate garden we will be focusing on the Entrance from the Mansion, the Core Terrace or Parterre, the location of the new Diversity Planting Beds and existing Stairwell planting beds, the Entrance into the garden via the parking lot, the Rose Bed and Japanese Maple Grove, and the Frog Pond. Further, other areas of improvement we also focused on include the Star Circle planting bed and the former pool which under our proposal will become the new Pollinator Garden. In the following pages, we will discuss the specific improvements that we propose for each of the areas listed above.

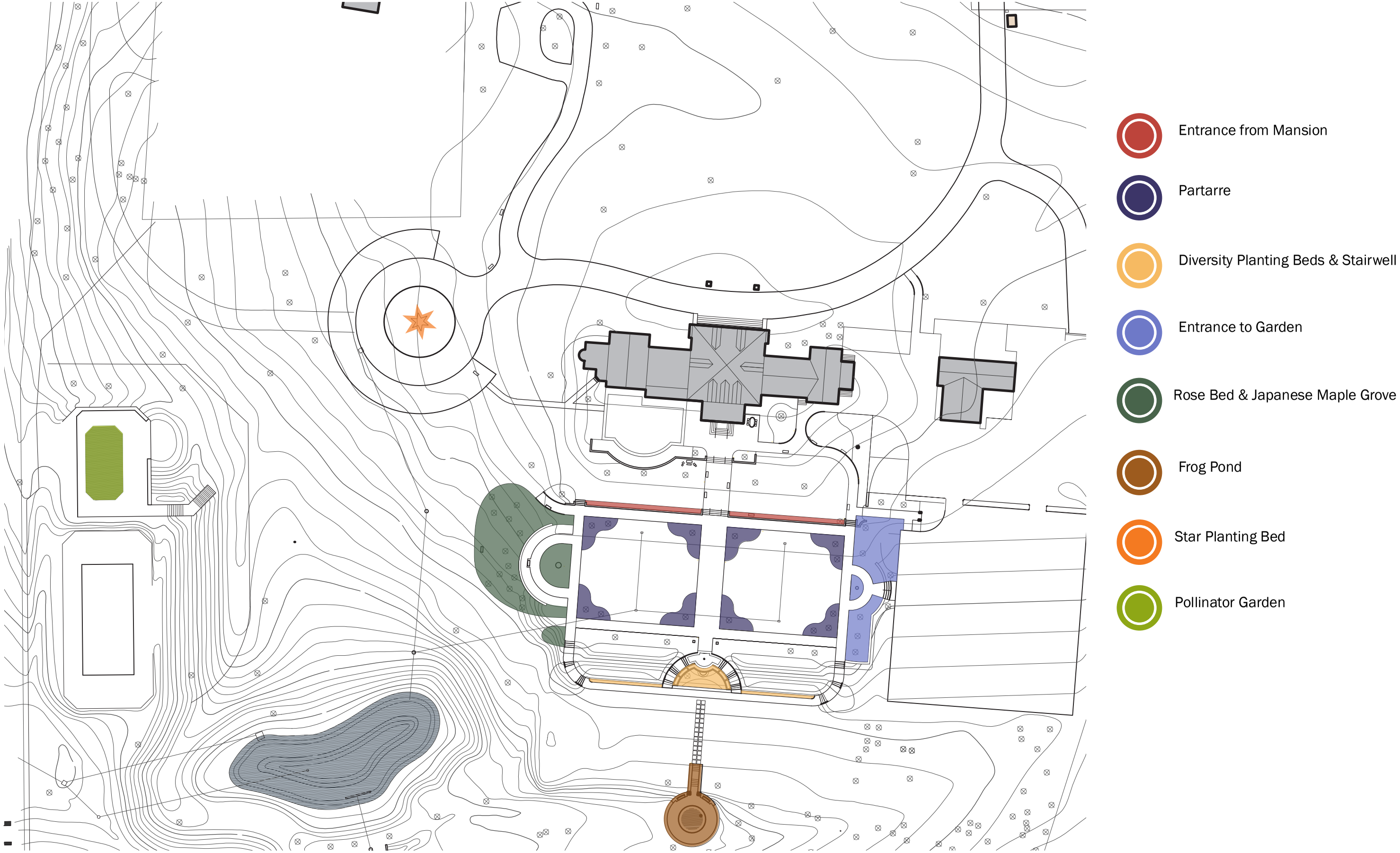


Figure 3.2 - Map depicting the areas of improvement that were focused on during this project.

Abbreviation	Quantity	Botanical Name	Common Name	Color	Height	Spread	Native	Soil Conditions			Light Needs			Season				Comments
								Dry	Average	Wet	Full Sun	Part Shade	Shade	Spring	Summer	Fall	Winter	
AH	27	*Amsonia hubrichtii*	Arkansas Amsonia	Blue	36"	36"	Y	x	x		x			x				Pollinator Garden
AI	18	*Asclepias incarnata*	Swamp Milkweed	White	36"	36"	Y	x	x	x	x				x			Pollinator Garden
AT	20	*Asclepias tuberosa*	Butterfly Weed	Orange	24"	24"	Y	x			x				x			Pollinator Garden
AO	25	*Aster oblongifolius 'October Skies'*	Aromatic Aster	Blue	24"	24"	Y	x	x		x					x		Pollinator Garden
AA	131	*Astilbe x arendsii 'Peach Blossom'*	Japanese Astilbe	Pink	24"	12"			x	x		x	x	x				
AN	141	*Athyrium niponicum*	Japanese Painted Fern		18"	18"			x			x	x					Representing Japan
BS	36	*Buxus sempervirens 'Justin Brouwers'*	Box Wood		2'	3'			x		x	x	x				x	Evergreen
CP	71	*Carex pensylvanica*	Pennsylvania Sedge	Yellow	8"	12"	Y		x	x		x	x	x				Rain Garden
CB	11	*Carpinus betulus 'Frans Fontaine'*	European Hornbeam		40'	20'		x	x	x	x	x					x	Winter Interest
CC	10	*Cercis canadensis*	Eastern Redbud	Pink	30'	25'	Y		x		x	x		x				
CK	2	*Cornus kousa Scarlet Fire®*	Scarlet Fire Dogwood	Pink	25'	20'			x		x	x			x			Fall Color
CL	7	*Curcuma longa*	Turmeric	Pink	4'	4'			x			x			x			Representing India
DP	14	*Delphinium 'Purple Passion'*	Hybrid Bee Delphinium	Purple	48"	24"			x		x	x			x	x		
DS	21	*Dicentra spectabilis*	Bleeding Heart	Pink	24"	18"			x			x	x	x				
EPM	42	*Echinacea purpurea 'Magnus'*	Purple Coneflower	Pink	36"	24"	Y	x	x		x				x			
EV	63	*Epimedium x versicolor 'Sulphureum'*	Sulfur Barrenwort	Yellow	12"	18"		x	x			x	x	x			x	Semi-Evergreen
EP	78	*Eryngium planum 'Big Blue'*	Sea Holly	Blue	24"	12"		x	x		x				x		x	Pollinator Garden
EM	32	*Eupatorium maculatum 'Phantom'*	Joe Pye Weed	Pink	36"	24"	Y		x	x	x				x		x	Pollinator Garden
GO	169	*Galium odoratum*	Sweet Woodruff	White	9"	18"			x	x		x	x	x				
GM	56	*Geranium maculatum*	Spotted Cranesbill	Pink	12"	18"	Y		x	x	x	x		x				Ground Cover
HK	18	*Hemerocallis 'Krakatoa Lava'*	Daylily	Orange	36"	24"		x	x		x				x			
HF	56	*Hosta 'Fire and Ice'*	Plantain Lily	Purple	20"	42"			x			x	x		x			
HA	2	*Hydrangea arborescens Incrediball® 'Blush'*	Smooth Hydrangea	Pink	4'	5'	Y		x	x	x	x			x			
IV	10	*Iris versicolor*	Blueflag Iris	Purple	24"	24"	Y			x	x	x		x				Rain Garden
LA	268	*Lavandula angustifolia 'Munstead'*	Munstead Lavander	Purple	18"	18"			x		x				x		x	Evergreen
LO	7	*Lonicera sempervirens 'Major Wheeler'*	Trumpet Honeysuckle	Red	8'		Y		x		x			x	x			Pollinator Garden
LC	22	*Lysimachia clethroides*	Gooseneck Loosestrife	White	36"	36"			x	x	x	x			x			Invasive
MV	18	*Mertensia virginica*	Virginia Bluebells	Pink-Blue	24"	36"	Y		x	x		x	x	x				
MD	50	*Monarda didyma 'Jacob Cline'*	Bee Balm	Red	36"	18"	Y		x	x	x				x			
NK	29	*Narcissus 'King Alfred'*	Daffodil	Yellow	2'	1'			x		x	x		x				
NL	2	*Nuphar lutea*	Spatterdock	Yellow	18"	6'	Y			x	x	x			x			
OC	26	*Osmunda cinnamomea*	Cinnamon Fern		36"	36"	Y		x	x		x	x					Rain Garden
PT	10	*Pachysandra terminalis*	Japanese Pachysandra	White	12"	18"			x			x	x	x			x	Evergreen
PS	30	*Phlox subulata 'Snowflake'*	Moss Phlox	White	4"	10"	Y	x	x		x	x		x				Ground Cover
PA	131	*Polystichum acrostichoides*	Christmas Fern		18"	24"	Y		x			x	x					
RY	9	*Rhododendron yedoense var. poukhanense*	Korean Azalea	Pink	3'	4'			x		x	x		x				Representing Korea
RI	28	*Rosa Icecap™*	Rose Shrub	White	3'	3'		x	x		x				x			
RK	9	*Rosa Knock Out®*	Rose Shrub	Red	6'	4'			x		x				x	x		
RF	67	*Rudbeckia fulgida var. sullivantii 'Little Goldstar'*	Black-Eyed Susan	Yellow	16"	16"	Y		x		x	x			x			
SS	206	*Schizachyrium scoparium 'Standing Ovation'*	Little Bluestem	Silver	48"	12"	Y	x	x		x					x		
VS	257	*Viola sororia*	Common Meadow Violet	Purple	6"	6"	Y	x	x	x		x		x	x			New Jersey State Flower
ZO	7	*Zingiber officinale*	Ginger	Pink	4'	3'			x			x			x			Representing India

Figure 3.3 - The planting schedule of all plants used in the proposed planting improvements and other relevant information.

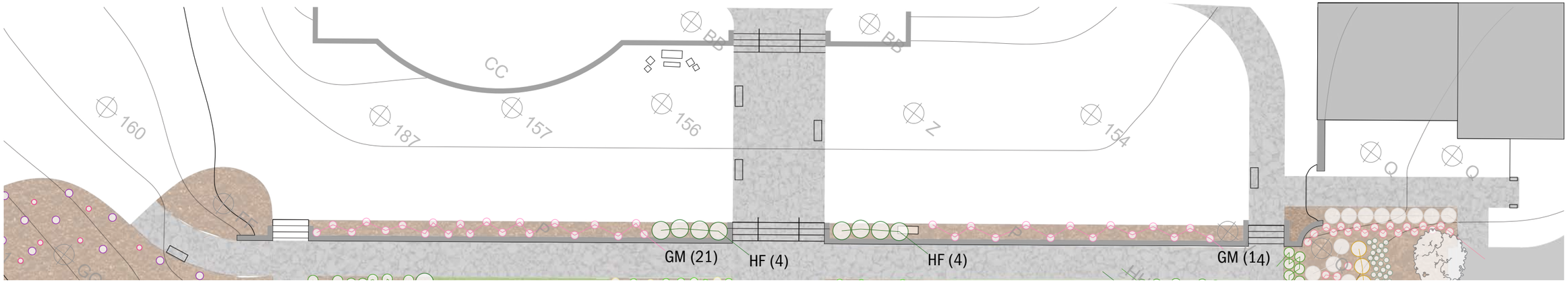


Figure 3.4 - Illustrated planting plan for the top edge of the Parterre.

Entrance From Mansion

The original design intend placed the beginning of the sequence of experiences of the Italianate Garden rooms as a continuity of the mansion's rooms. Leaving the mansion, the visitor descends a short flight of stairs to enter the Parterre. The well-established 1992 plantings of the Parterre are partly blocking sunlight for the existing juniper ground cover planting, causing the decline of some plants while others still thrive. We propose to replace the dead Junipers with Spotted Cranesbill (*Geranium maculatum*) to fill in the areas that currently devoid of ground cover. The Spotted Cranesbill will be able to survive in the varied light conditions of this bed. For the planting area closest to the main walkway into the garden, we noticed the current plants on the left-hand side were not thriving under the dense shade of the overhead canopy. To combat this, we proposed the addition of Plantain Lily (*Hosta' Fire and Ice'*) to both sides of the walkway to create symmetry within the gardens with a plant selection that can thrive even in heavy shade.

GM *Geranium maculatum*
Spotted Cranesbill [1]

HF *Hosta 'Fire and Ice'*
Plantain Lily [1]

Parterre

The Parterre is the heart of the Italianate Garden at Drumthwacket. The 1992 plantings of four Japanese Dogwood, (*Cornus kousa*, HH), four evergreen Southern Magnolia (*Magnolia grandiflora*, JJ) and two remaining Linden Viburnum (*Viburnum dilatatum*, II) provide a symmetric spatial structure, while the ground level planting is spotty at best.

We focused on three sections: the outer planting beds, the inner planting beds, and the bottom edge planting beds. We preserve the symmetry of the garden while also keeping in mind the varying amounts of sunlight, causing diverse growing conditions.

In the outer planting beds, we used Christmas Ferns (*Polystichum acrostichoides*) and Plantain Lilies (*Hosta' Fire and Ice'*) with the Christmas Ferns mostly lining the walkway and the Plantain Lilies facing the core of the garden. These plants were selected for their hardiness in low light conditions and evergreen qualities that will keep the garden green even in winter. In the inner planting beds, we decided to use two ground covers Sulfur Barrenwort (*Epimedium x versicolor 'Sulphureum'*) and Sweet Woodruff (*Galium odoratum*). The four magnolias that line the main walkway are the centerpiece; therefore we use a simple ground cover that would not detract from the beautiful foliage of the existing trees, but provide some interest as the white and yellow flowers pop up in the spring. The final improvement made to the core terrace of the garden is in the bottom edge planting beds that previously held the River Birch trees. In this area, we propose to first replace the four River Birch with five Eastern Redbuds (*Cercis canadensis*) on either side of the walkway. The Eastern Redbud is more to scale with the rest of the garden and will bear pink flowers in the spring to add more color to the Parterre overall. To fill in the planting bed below, we will add in a spring garden on either side of the existing Peonies. The spring garden will include a mix of Bleeding Hearts (*Dicentra spectabilis*), Daylilies (*Hemerocallis 'Krakatoa Lava'* or other varieties), Virginia Bluebells (*Mertensia virginica*), and Daffodil's (*Narcissus' King Alfred'*). These spring flowers will bloom in succession to each other over the course of a few months starting with the Virginia Bluebells in April, then the Daffodil's, Bleeding Hearts, and ending with the Day lilies in June. This spring garden will be a crucial component of bringing color back into the Italianate Garden all spring when visitations are highest at Drumthwacket. Overall, this new planting scheme for the Parterre will ensure that the garden remains colorful all spring long and even retain attractive in the winter months with the addition of evergreen ferns.

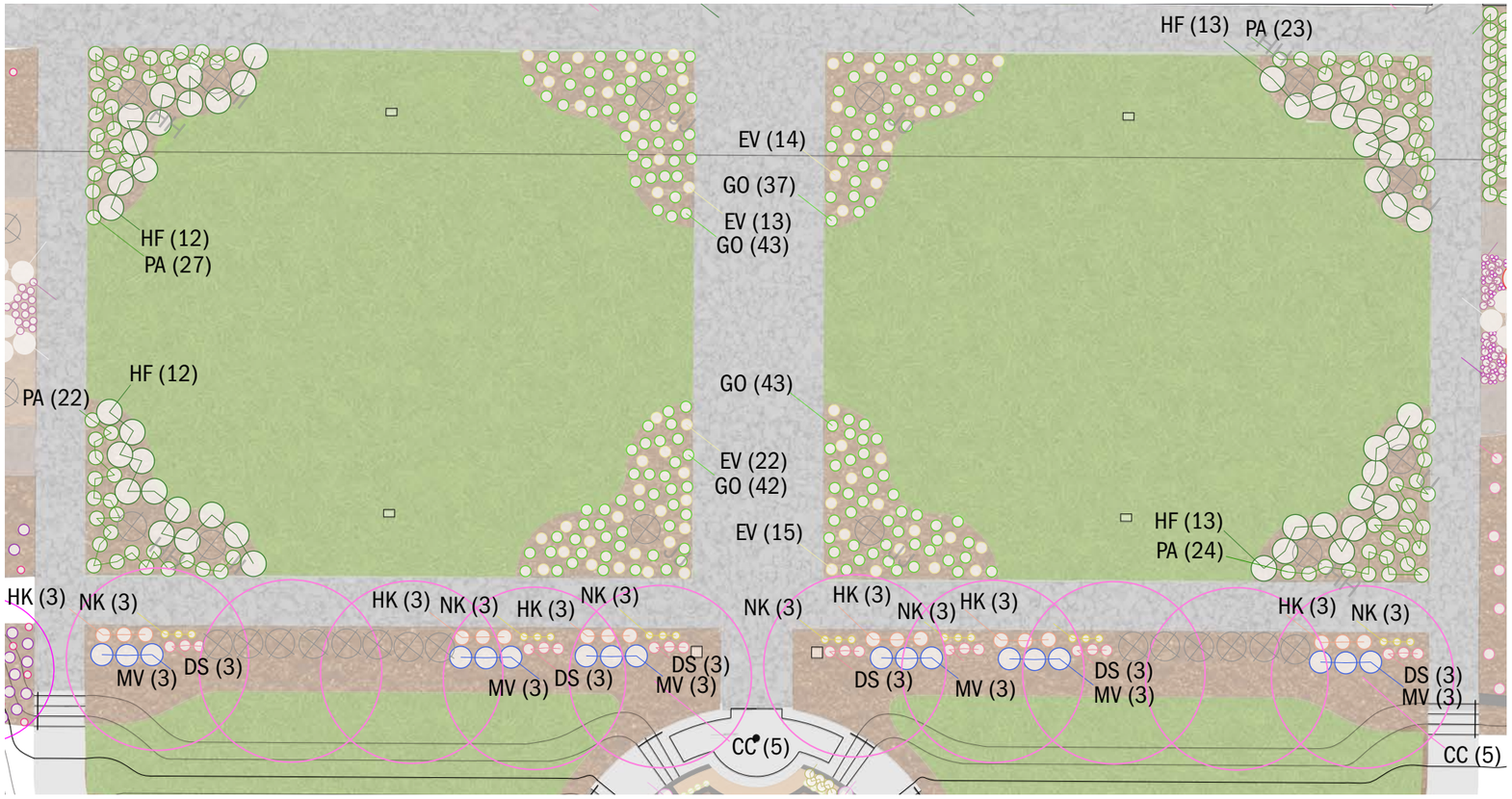


Figure 3.5 - Illustrated planting plan for core terrace or Parterre of the Italianate Garden.

CC *Cercis canadensis*
Eastern Redbud 1

DS *Dicentra spectabilis*
Bleeding Heart 2

EV *Epimedium x versicolor 'Sulphureum'*
Sulfur Barr

GO *Galium odoratum*
Sweet Woodruff 1

HK *Hemerocallis 'Krakatoa Lava'*
Daylily 3

MV *Mertensia virginica*
Virginia Bluebells 1

NK *Narcissus 'King Alfred'*
Daffodil 1

PA *Polystichum acrostichoides*
Christmas Fern 1

Diversity Planting Beds & Stairwell

The idea of diversity plantings was developed by Rutgers students in the fall 2018 Drumthwacket design studio. The students discussed that the garden should be a garden of the people and that New Jersians are of diverse ethnic and cultural backgrounds. In conversation with the Drumthwacket Foundation we identified the beds along the bottom tier of the Italianate Garden as suitable to carry over the student's idea.

Our vision is to transform the bottom level planting beds into a Diversity garden that could showcase the many countries of origin for New Jersey immigrants. It is more important now than ever before for immigrants to know that they have a place in our state and what better way to do that than with a Diversity Garden dedicated to the people that make up our state. The right-hand side of bottom tier planting beds would be dedicated to India by using Tumeric (*Curcuma longa*), Ginger *(Zingiber officinale*), a mix of Pennsylvania Sedge (*Carex pensylvanica*), and tied together with the New Jersey state flower Common Meadow Violet (*Viola sororia*). The opposite side would represent Korea by planting Korean Azalea (*Rhododendron yedoense var. poukhanense*) with the same mix of Pennsylvania Sedge grass and Common Meadow Violet. The outer planting beds would be a representation of Japanese immigrants by planting Japanese Painted Ferns (*Athyrium niponicum*) and Japanese Astilbe (*Astilbe x arendsii 'Peach Blossom'*) to correspond to the grove of Japanese Maple trees already on the property. The diversity of flowers and leaves from foreign and native plants evolves into a new and unique planting palette, reflecting how valuable and special the people in New Jersey are.

The diversity plantings frame more traditional garden plantings in the stairwells' elevated planting boxes. We are proposing to add in a Moss Phlox which will hang over the edge of each box. In the upper most planting box Black-eyed Susan, followed by Purple Coneflower, then Hybrid Bee Delphinium on the lowest planting box. In the center of the stairwell, we will add Black-eyed Susan's around the fountain and plant Daffodils in the grass patch which could be converted to a low mow area that gets cut with the Daffodils after they are finished blooming in the spring.

Japan

AA *Astilbe x arendsii 'Peach Blossom'*
Japanese Astilbe [1]

AN *Athyrium niponicum*
Japanese Painted Fern [1]

Korea

RY *Rhododendron yedoense var. poukhanense*
Korean Azalea [1]

India

CL *Curcuma longa*
Turmeric [6]

ZO *Zingiber officinale*
Ginger [8]

New Jersey

VS *Viola sororia*
Common Meadow Violet [1]

DP *Delphinium 'Purple Passion'*
Hybrid Bee Delphinium [2]

EPM *Echinacea purpurea 'Magnus'*
Purple Coneflower [1]

RF *Rudbeckia fulgida var. sullivantii 'Little Goldstar'*
Black-Eyed Susan [1]

PS *Phlox subulata 'Snowflake'*
Moss Phlox [2]

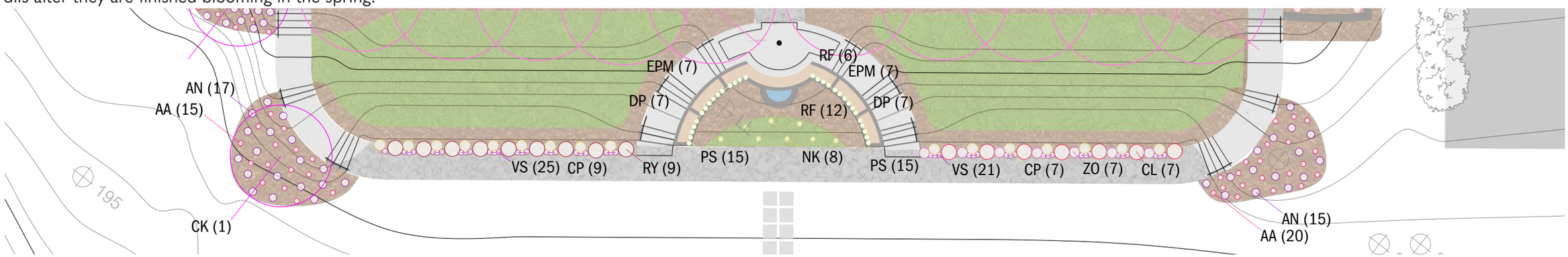


Figure 3.6 - Illustrated planting plan for the proposed Diversity Planting beds and stairwell plantings in the Italianate Garden.

Rose Bed and Japanese Maple Grove

These rose plantings highlighting the statue are the larger counterpart to the rose plantings at the western edge. With this bed being slightly larger than the entrance rose bed, the Icecap Roses were added in groups of four on either side of the statue with Lavender and Common Meadow Violet in between them. Along the back of the bed, an edge of Lavender and Violet would border on a row of Icecap and Knock Out roses. By re-establishing symmetry of the plantings, we maintain the formality of classic Italianate garden design.

The adjacent plantings of Japanese Maple (*Acer palmatum*) provide a backdrop for the rose plantings and a transition to the landscape portion of Drumthwacket Garden. To add seasonal interest and color we propose to plant a ground cover of Japanese Painted Ferns and Japanese Astilbe. In the two lower planting beds, we propose the addition of two Scarlet Fire Dogwood (*Cornus kousa Scarlet Fire*) to replace a lost shrub.

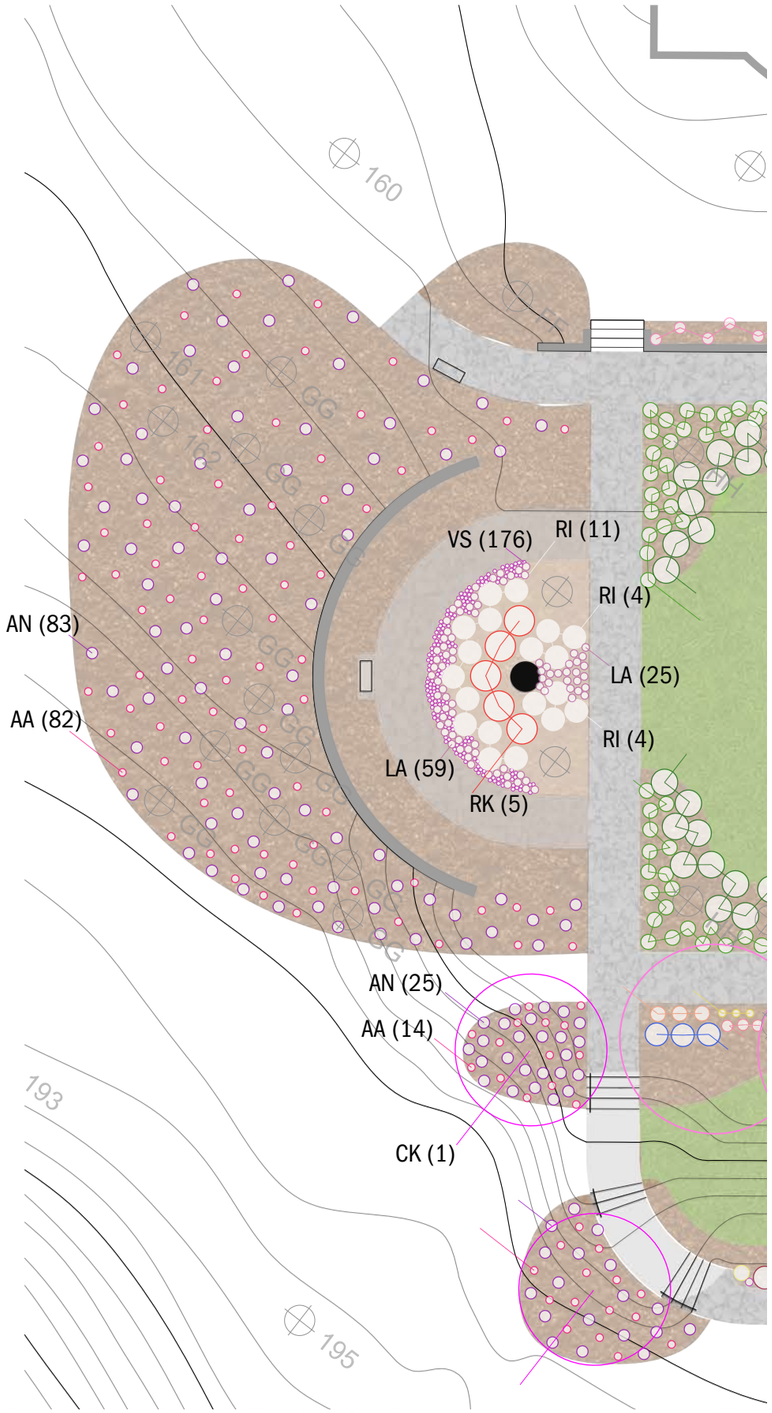


Figure 3.7 - Illustrated planting plan of the improved rose bed and Japanese Maple grove.

AA *Astilbe x arendsii 'Peach Blossom'*
Japanese Astilbe 1

AN *Athyrium niponicum*
Japanese Painted Fern 1

CK *Cornus kousa Scarlet Fire®*
Scarlet Fire Dogwood 5

LA *Lavandula angustifolia 'Munstead'*
Munstead Lavander 1

RI *Rosa Icecap™*
Rose Shrub 3

RK *Rosa Knock Out®*
Rose Shrub 2

VS *Viola sororia*
Common Meadow Violet 1

Entrance into Garden

The expansion of the parking lot has a negative visual impact on the eastern section of the Italianate Garden and makes the side entrance more important. Our planting improvements follow the intention that once a visitor is in the garden direct sight lines to the parking lot are minimized as much as possible to separate the two areas. We screened the parking lot using a clipped hedge of European Hornbeam (*Carpinus betulus 'Frans Fontaine'*) along the west edge of the parking lot. As visitors walk up the center steps, they are greeted by two Hydrangea (*Hydrangea arborescens Incrediball® 'Blush'*) shrubs with a sea of Munstead Lavender (*Lavandula angustifolia' Munstead'*) surrounding it. Along the upper pathway from the parking lot, we chose to mirror the existing planting of Gooseneck Loosestrife *(Lysimachia clethroides*) that runs along the opposite side of the walkway. We layered in Little Bluestem (*Schizachyrium scoparium' Standing Ovation'*), Bee Balm (*Monarda didyma' Jacob Cline'*), Cinnamon Fern (*Osmunda cinnamomea*), and Christmas Fern (*Polystichum acrostichoides*) to add color and variety into the planting bed over multiple seasons.

In the rose bed, we recommend switching out the existing soil to allow the new roses to thrive after being established. To enable the current statue to shine, we will line the back with Red Knock Out Roses (Rosa Knock Out) and the front with white Ice Cap Roses (Rosa Icecap). In either corner, we will have Lavender and Common Meadow Violet to further tie in the New Jersey state flower to the overall planting scheme of the garden. This new improvement area strategically screens the parking lot while packing multiple seasons of color into this revived entrance sequence into the core terrace of the Italianate garden.

CB *Carpinus betulus 'Frans Fontaine'* European Hornbeam

GM *Geranium maculatum* Spotted Cranesbill 1

HA *Hydrangea arborescens Incrediball 'Blush'* Smooth Hydrangea 1

LA *Lavandula angustifolia 'Munstead'* Munstead Lavander 1

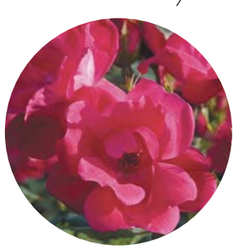
LC *Lysimachia clethroides* Gooseneck Loosestrife 1

MD *Monarda didyma 'Jacob Cline'* Bee Balm 7

OC *Osmunda cinnamomea* Cinnamon Fern 1

PA *Polystichum acrostichoides* Christmas Fern 1

RI *Rosa Icecap™* Rose Shrub 3



RK *Rosa Knock Out®* Rose Shrub 2

SS *Schizachyrium scoparium 'Standing Ovation'* Little Bluestem 1

VS *Viola sororia* Common Meadow Violet 1

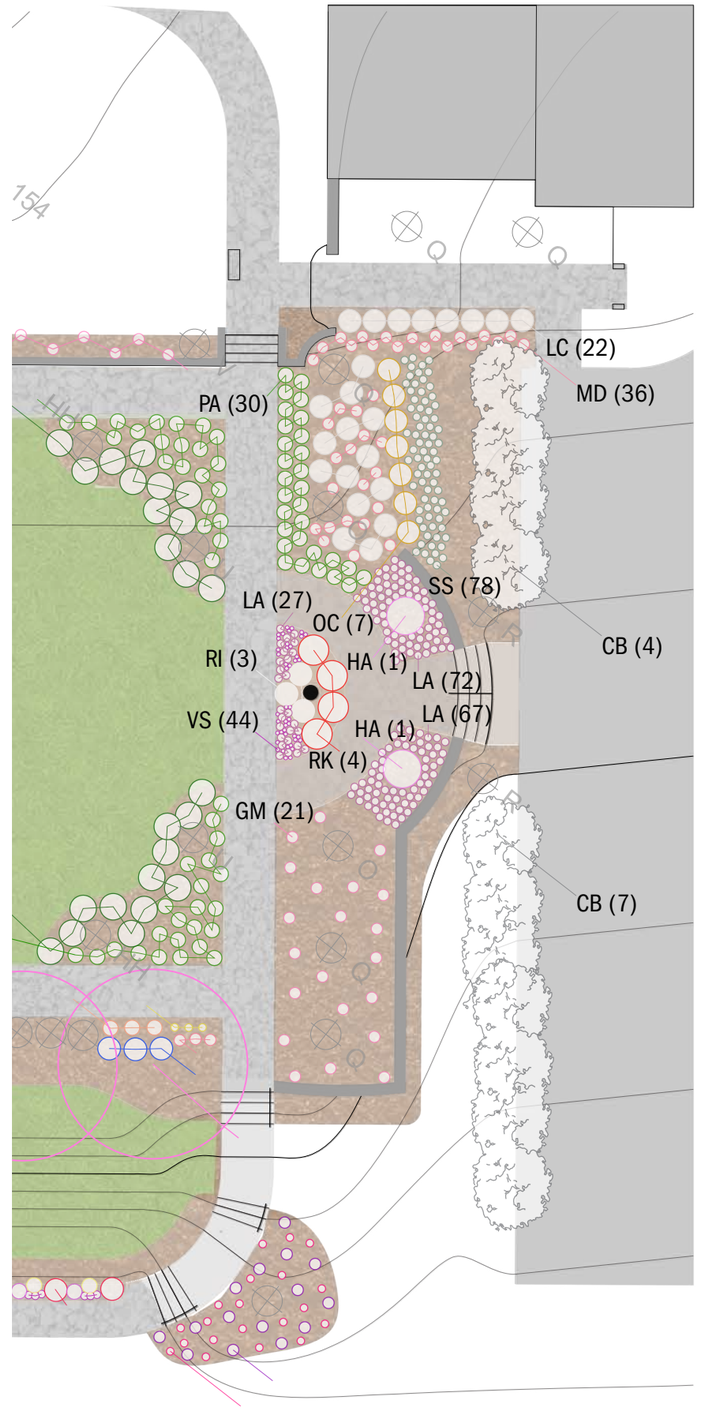


Figure 3.8 - Illustrated planting plan for the entrance from the parking lot into the Italianate Garden and improved rose bed.

The Frog Pond

The frog pond is the terminus of the garden experience, an intimate garden space that celebrates the miracles of the wilderness in the Italianate Garden tradition. Most of the existing plantings are well established, only minor improvements are needed. A few bald spots in the existing Japanese Pachysandra (*Pachysandra terminalis*) and Christmas Fern (*Polystichum acrostichoides*) need to be filled.

The frog pond itself will be improved by adding yellow Spatterdock (*Nuphar lutea*), a shade-tolerant aquatic plant, and a frog ladder that will improve habitat quality for the frogs living in the pond. To maintain an open water portion in the pond, the native Spatterdock should be planted in containers, additional mechanical growth control may be required.

NL *Nuphar lutea*
Spatterdock 1

PT *Pachysandra terminalis*
Japanese Pachysandra 1

PA *Polystichum acrostichoides*
Christmas Fern 1

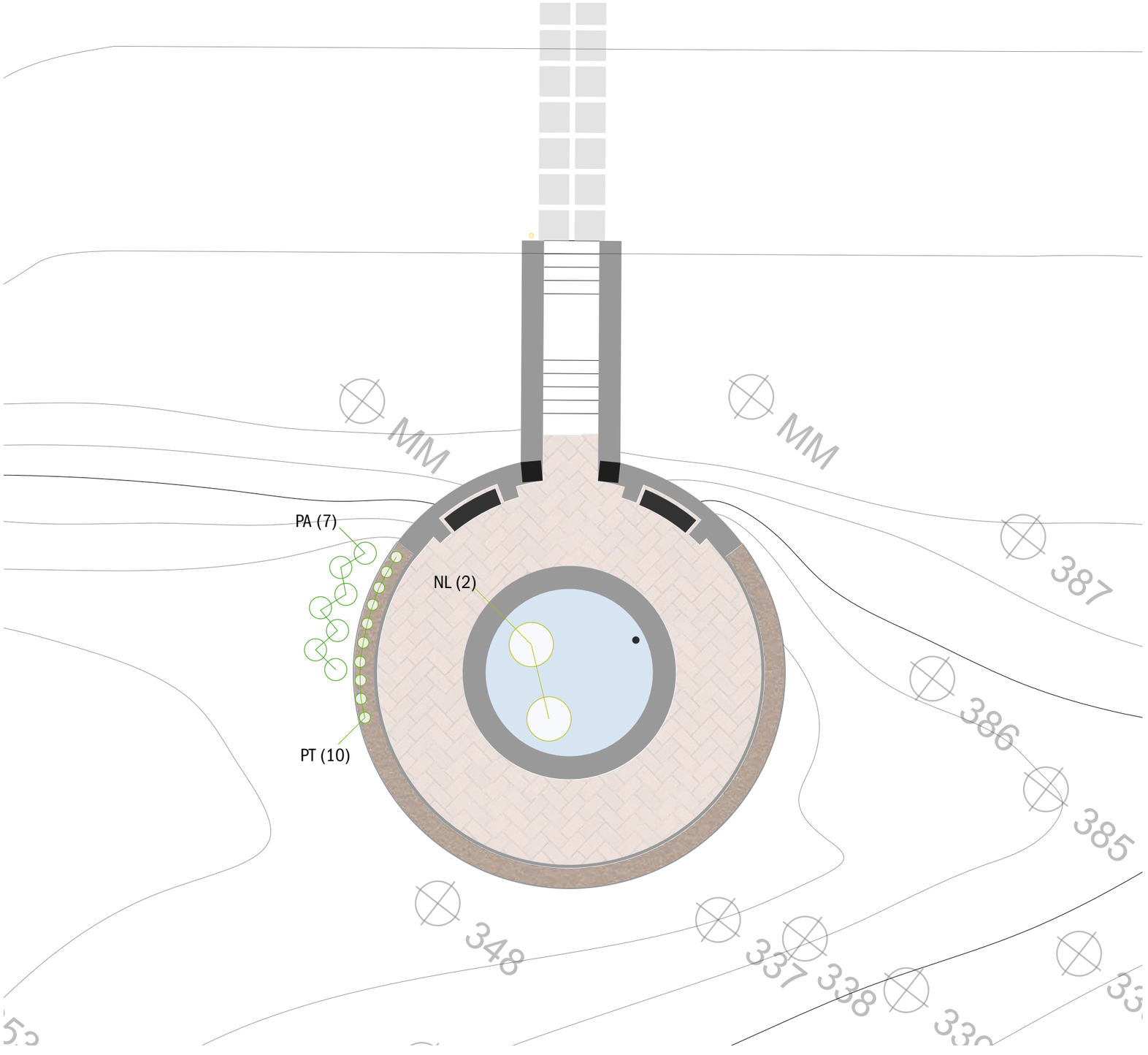


Figure 3.9 - Illustrated planting plan of the Frog Pond in the Italianate Garden.

Reviving the Star Circle Planting Bed

The Star Planting bed and the Well Head are among the few remaining historical artifacts at Drumthwacket but are fallen in disrepair. The existing Box Wood planting is spotty and takes away from the shape rather than accentuate it. We suggest to replace all the existing Box Wood with a new variety called *Buxus sempervirens 'Justin Brouwers'* that will not only thrive in the tight planting pattern but will work very well as a small hedge around the planting bed. For the center, we will continue the planting palette found in the rose beds by using a cluster of the Ice Cap Roses directly in the center and the Munstead Lavender in the points of the star. Overall, this new revival of the Star Planting Bed will help to re-establish it as the centerpiece of the traffic circle which will be a vital component of the newly constructed entrance along the west edge of the property.

BS *Buxus sempervirens 'Justin Brouwers'*
Box Wood [3]

LA *Lavandula angustifolia 'Munstead'*
Munstead Lavander [1]

RI *Rosa Icecap™*
Rose Shrub [3]

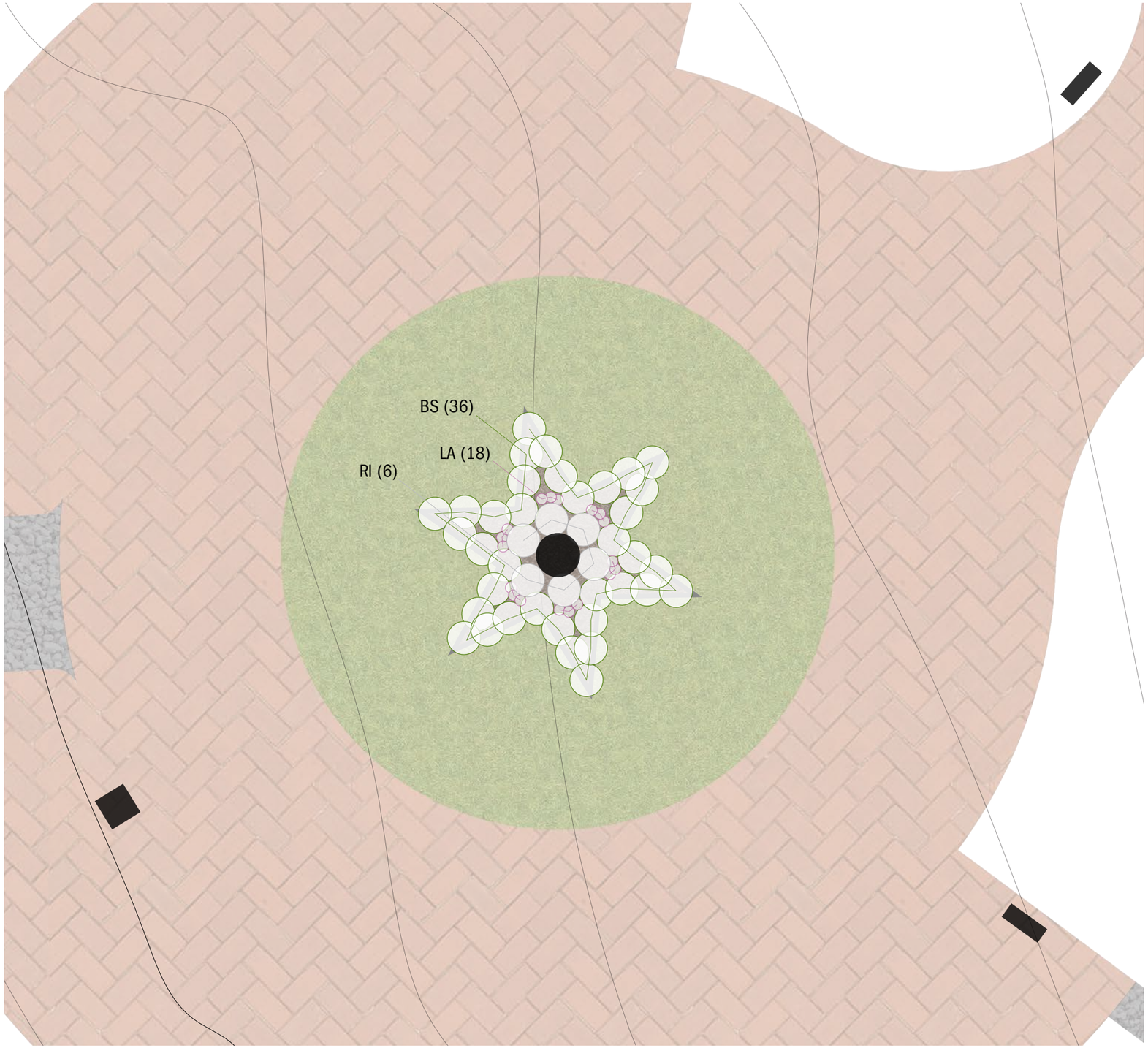


Figure 3.10 - Illustrated planting plan for the Star Circle Planting Bed.

Creating a Pollinator Garden in the Former Pool

The discussion about the future of the private pool and the pool house is not yet finalized, however, the installation of a soccer field on the site of the former tennis court makes it unlikely that the current designation as private pool area will continue. Rather we suggest to transform the pool into a planting bed as one option.

That transformation will require to drain the pool and to drill holes in the base for drainage. The next step is to install a drainage layer of rocks and a layer of rocky soil that would assure that water was percolating through the bed without becoming waterlogged. A final layer of topsoil would then be added thus allowing plants to be installed in the new planting bed.

In line with the overall sustainability theme, we propose a low maintenance Pollinator Garden. This will provide food and habitat for a variety of pollinators while also adding colors and texture to this long-neglected corner of the Drumthwacket property. The selection of native plant material will attract a variety pollinators. A large grass swath at the garden's center of Little Bluestem (*Schizachyrium scoparium 'Standing Ovation'*) allows the pollinators an inner sanctuary where they can rest without human interaction. Around the outer edge of the garden, we added in plants that specifically attract the New Jersey State Butterfly, the Black Swallowtail (*Papilio polyxenes*), such as Bee Balm (*Monarda didyma 'Jacob Cline'*), Coneflower (*Echinacea purpurea 'Magnus'*), Butterfly Weed (*Asclepias tuberosa*) , and Joe Pye Weed (*Eupatorium maculatum 'Phantom'*).All plants present in this garden are pollinator-friendly and will be beneficial for the proposed beehive on the property and other species, as well. The concrete retaining wall will be covered with Trumpet Honeysuckle (*Lonicera sempervirens 'Major Wheeler'*), planted at the base of walls it will grow up with the assistance of cables and attract hummingbirds when in bloom.

By having this section of Drumthwacket dedicated to the Pollinator Garden, it will allow the property to showcase the importance of all pollinators as well as educate the general public on how to make their own planting beds more appealing for pollinators.

AH *Amsonia hubrichtii*
Arkansas Amsonia 1

AI *Asclepias incarnata*
Swamp Milkweed 1

AT *Asclepias tuberosa*
Butterfly Weed 1

AO *Aster oblongifolius 'October Skies'*
Aromatic Aster 1

EPM *Echinacea purpurea 'Magnus'*
Purple Coneflower 1

EP *Eryngium planum 'Big Blue'*
Sea Holly 1

EM *Eupatorium maculatum 'Phantom'*
Joe Pye Weed 1

MD *Monarda didyma 'Jacob Cline'* Bee Balm 7

RF *Rudbeckia fulgida var. sullivantii 'Little Goldstar'*
Black-Eyed Susan 1

SN *Salvia nemorosa 'Caradonna'*
Hybrid Sage 1

SS *Schizachyrium scoparium 'Standing Ovation'*
Little Bluestem 1

LO *Lonicera sempervirens 'Major Wheeler'*
Trumpet Honeysuckle 1

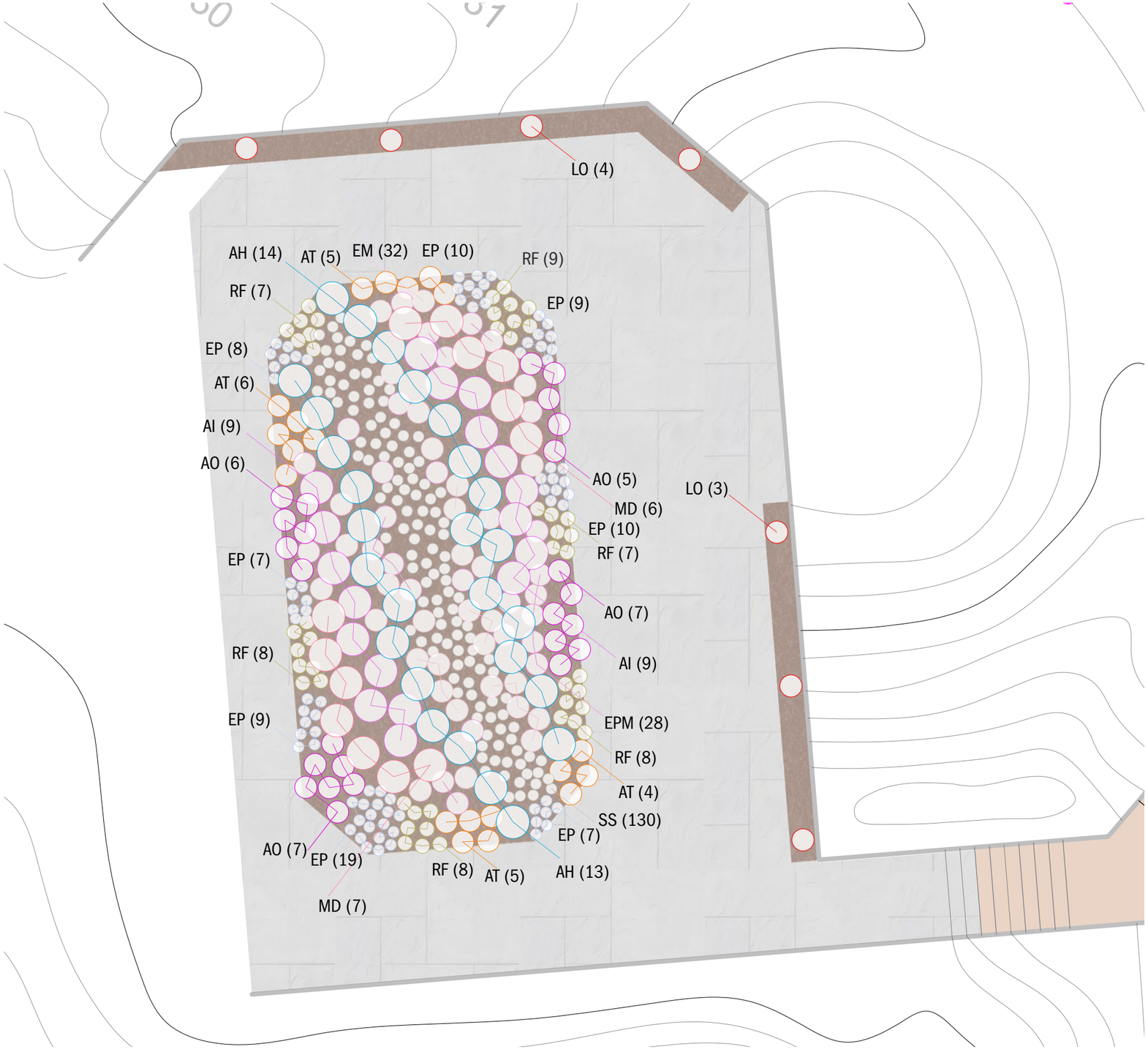


Figure 3.11 - Illustrated planting plan of the proposed Pollinator Garden located int he former pool.

Figure 3.12 - Photo of a Hummingbird visiting a Honeysuckle flower. Image by Providence Journal.

Figure 3.13 - Photo of a Swallowtail Butterfly visiting a yellow flower. Image by Beautiful Butterfly Pictures.

Figure 3.14 - Photo of a bee visiting a Sea Holly flower. Image by Cobalt Wildlife.

CREATING A NEW SUSTAINABLE DRUMTHWACKET

Figure 4.1 illustrates how all proposed improvements will interact with one another on the Drumthwacket property. Visitors and residents will be able to experience a historic garden which also features well applicable solutions for sustainable garden management.

The addition of the Garden State Parkway wildflower mix along the front edge of the property and the road will provide a colorful first impression. As they pass by the guard booth, visitors will be greeted by the new Drumthwacket beehives which will include educational signage visible from cars that explain what the boxes while avoiding unwanted interactions with bees.
A rain garden is placed prominently near the front entrance of the mansion. The crisp modern design is in line with the symmetry of the historic building, celebrating sustainable storm water management as design element. The garden's function is made visible using channels redirecting water from the downspouts into the garden where it percolates back into the soil. Signage explains the basic functions of the garden and why climate change and the increasing amount of impervious surfaces across the state require the further implementation of sustainable storm-water management

The visitors' arrival experience is improved at both parking lots. Visitors using the newly added parking at the star circle will experience renewed boxwood and roses. At the main parking lot, the Garden State Parkway wildflower mix from the main entrance is extending along the northern side of the parking lot, providing color until the new tree plantings are established (some will need replacement).

After visitors park their cars, they will make their way inside the mansion for the scheduled tours before exiting out onto the top tier of the revived Italianate Garden. Guests will be greeted by a lush landscape which offers multi-seasonal interest including vibrant fall foliage, evergreen ferns in the winter, colorful early spring flowers, and picturesque summer blossoms throughout the entire garden. With the proper maintenance, the twin rose beds will invite visitors to tour the entirety of the garden rather than just the center corridor. After they stroll the parterre, guests can descend the stairwell to check out the new Diversity Planting beds where they can learn about why Drumthwacket chose these plants for this section of the garden and what they represent with the help of distinct signage. As visitors travel further down the slope towards the Frog Pond, they will emerge into a lush forest canopy with colorful aquatic plants dotting the pond. With the addition of frog ladders, guests will be more likely to spot a friend enjoying the new habitat just as much as they are.

Once visitors are done exploring the Italianate Garden, they are welcome to check out the retention pond and sprawling lawn as they make their way up towards the meadow. The new section of meadow grasses and perennial flowers will feature a path for visitors to traverse as signage guides them through the meadow as they call out particular species of plants, the function of the meadow, and any wildlife they are likely to see utilizing the resources created by the meadow. This path will lead them to the Pollinator Garden and Soccer Field area of the property, where they can learn more about the importance of pollinator-friendly plants, the different types of pollinators in New Jersey, and why they are so crucial to the success of our ecosystem and agricultural endeavors. Signage hung around the garden will identify the different species of plants used and how the private pool was converted into a planting bed for this express purpose.

After guests have enjoyed the Pollinator Garden, they can climb back up the hill towards the front of the mansion. They will pass the new composting pile tucked into the trees where they can choose to continue the tour or check out the informative postings next to the compost. These signs will explain how compost is used around the garden, what they put in it, and how guests can establish their own at home.

On their way back to their cars in the parking lot, guests have the option to venture closer to the beehives to get a closer look and learn a bit more about the process of operating a beehive on site. Information about the GSP wildflower seed mix can also be displayed here, as well, to help promote the use of the seed mix across the state. With that last stop, visitors can leave Drumthwacket knowing a lot more about the different sustainable practices possible at a residential scale than when they drove onto the property. Hopefully, they may even feel inclined to implement one or more of these same practices in their own neighborhoods.

Once the improvements suggested in this report are implemented, Drumthwacket's garden will provide an entirely new structure for visitors to enjoy. The different sustainable aspects of the property will now act as anchor points for visitors to discover as they make their way around the grounds, stopping at as many or as few as they like. This system offers guests the option to learn as much as they want about these practices, but also provides added interest for those who are just looking for a picturesque stroll through this historic property. The new Sustainable Drumthwacket offers numerous ways for New Jersey residents to implement ecologically responsible designs into their backyards whether they are looking for a project as small as a compost pile or as complex as establishing a meadow. We suggest adding a section to the Drumthwacket website that offers more in-depth information on these projects that visitors could reference at home. These links can be featured on the corresponding signage in the form of QR codes for simple navigation.

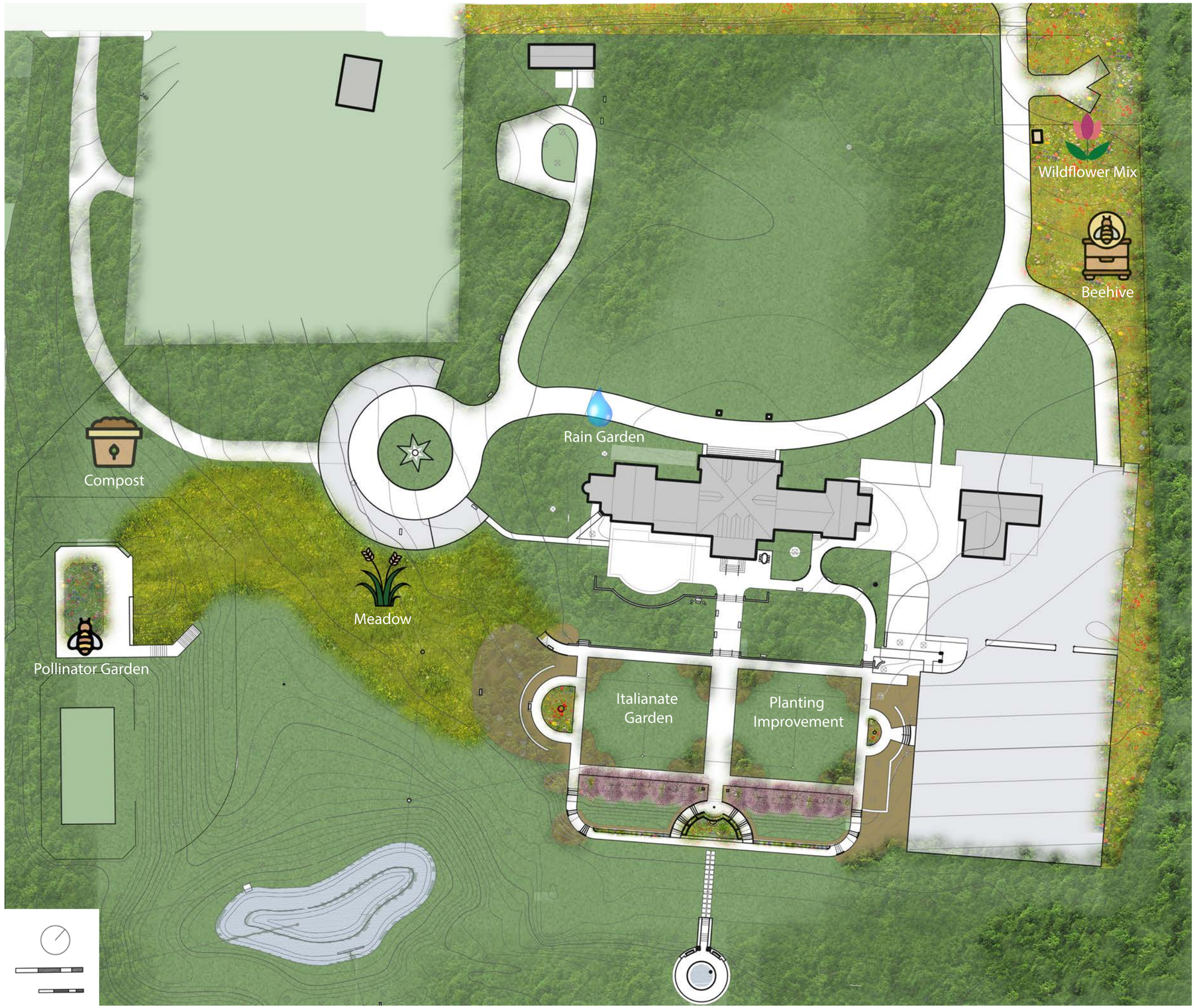


Figure 4.1 - A rendered plan illustrating how the proposed improvements would work together to enhance the visitors experience at Drumthwacket.

CHANGES TO THE MAINTENANCE REGIME

Maintenance of Drumthwacket Garden is currently divided up between external contractors, state employees, and volunteers. Although all individuals involved are fully committed and often work beyond their obligations, the slow but steady decline of the garden shows that maintenance must be improved.

In Figure 5.1, we have compiled a Maintenance Plan to outline all the changes we have proposed for Drumthwacket and how it would impact the existing maintenance regime. We broke up the required maintenance by the sections of the property, then listed the corresponding tasks, followed by the season and frequency in which they will need to be performed, along with the total hours spent on the task per year. Using this logic, we were able to determine approximately how many hours annually of maintenance each section the estate would require to maintain the necessary improvements laid out in this report. After adding up the total number of hours needed to maintain the garden, we determined that the current regime upheld by the volunteer Master Gardeners would be insufficient to cover all the new improvements made to the property. To make up for this gap in human resources, we are proposing a full-time gardener be added onto the Drumthwacket staff. The full-time gardener would be able to oversee the day to day tasks, as well as volunteer coordination and the newly added educational aspects of Drumthwacket. The newly hired gardener would be an essential asset to ensuring that the improvements made to Drumthwacket remain effective through routine maintenance and consistent care. To offset the additional costs of the new hire, Drumthwacket could save money by utilizing proposed programs such as the on-site composting as a substitute to the store-bought wood-chip mulch or by replacing the need for outside mowing services. Overall, this addition to the Drumthwacket staff will be a valuable investment that assures the proposed improvements remain effective long after installation.

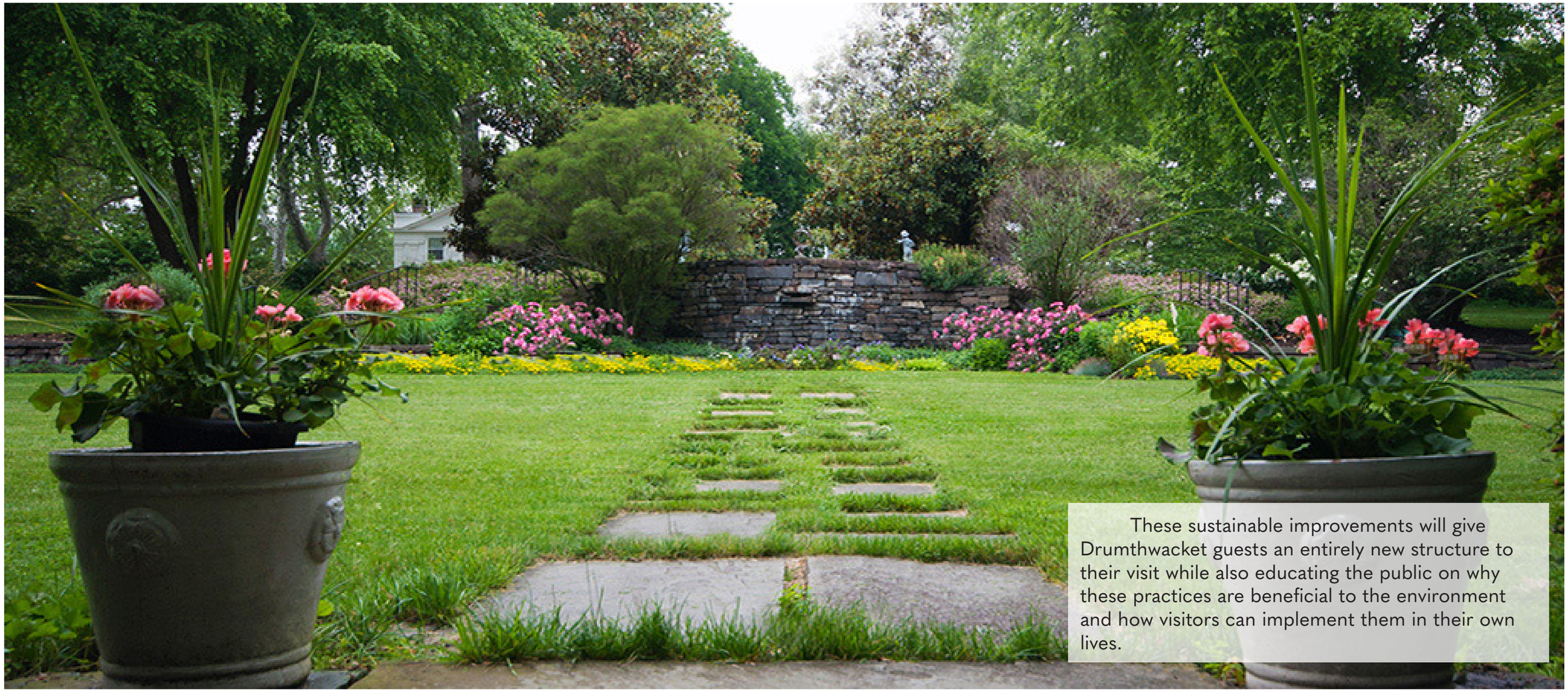
Maintenance Areas	Task	Fall	Winter	Spring	Summer	Frequency	Hrs/week	Hrs/biweekly	Hrs/month	Hrs/season	Hrs/year	Total Hours Per Year
Italianate Garden												**301.5 hours / year**
	Deadhead Roses			x	x	Bi-Weekly		3				39
	Shear Hedges	x		x		Bi-Annual					8	8
	Weeding	x		x	x	Bi-Weekly		8				156
	Preparation For Spring			x		Seasonal				24		24
	Trimming Magnolias		x			Annual					16	16
	Frog Fountain Maintenance	x		x	x	Bi-Weekly		3				58.5
Star Planting												**78 hours / year**
	General Maintenance	x		x	x	Bi-Weekly		4				78
Pollinator Garden (former pool)												**312 hours / year**
	General Maintenance	x		x	x	Bi-Weekly		16				312
Pond												**32 hours / year**
	Remove Plant Surplus	x		x		Seasonal				16		32
Rain Garden												**76 hours / year**
	Clear Drains	x	x	x	x	Monthly			4			48
	Fall Trimming	x				Seasonal				4		4
	Winter Clean Up			x		Seasonal				24		24
Meadow												**164 hours / year**
	Cut Back		x			Seasonal				8		8
	Weed Control	x		x	x	Bi-Weekly		8				156
Miscellaneous												**1,107 hours / year**
	Fall/Summer Mowing	x			x	Bi-Weekly		16				208
	Spring Mowing			x		Weekly	8					104
	Snow/Ice Removal		x			Average				40		40
	Path Clearance	x	x	x	x	Daily		8				208
	Community Outreach	x	x	x	x	Weekly	4					208
	Fall Leaf Clean Up	x				Seasonal				64		64
	Sycamore Debris Clean Up			x		Seasonal				8		8
	Winter Planning		x			Annual					16	16
	Genral Garden Care	x	x	x	x	Bi-Weekly		8				208
	Edge Beds		x			Seasonal				8		8
	Pruning Trees/Shrubs		x			Seasonal				35		35

Estimated Hours of Full Time Gardener:
1680 hours / year

Surplus Hours for Volunteer Work:
390.5 hours / year

Total Number of Hours:
2,070.5 hours / year

Figure 5.1 - A maintenance plan used to estimate the total amount of work each section of the garden would need with the proposed improvements to the estate.



These sustainable improvements will give Drumthwacket guests an entirely new structure to their visit while also educating the public on why these practices are beneficial to the environment and how visitors can implement them in their own lives.

Figure 5.2 - Photo of the Italianate Garden from the Frog Pond. Image by The Drumthwacket Foundation.

LIST OF SOURCES

Figures

Figure 2.4 - Example of a perennial meadow next to a mowed lawn. Larry Weaner landscape associates. http://lweanerassociates.com/?portfolio-category=meadows-natural-areas. Accessed 29 July 2019.

Figure 2.6 - Photo of Garden State Parkway Wildflower mix along the Parkway. Patch. https://patch.com/new-jersey/montclair/garden-state-parkway-wildflower-seeds-now-available-new-jersey. Accessed 19 August 2019.

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Figure 2.9 - Example of a traditional beehive box. Northcreek Nurseries. http://northcreeknurseries.blogspot.com/2014/?m=0.
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Figure 2.10 - Example of a Mason Bee hive mounted in a tree. Gardener's Supply Company. https://www.gardeners.com/how-to/about-mason-bees/8198.html. Accessed 22 July 2019.

Figure 2.12 - Example of caged compost pile. Grow It Organically. https://www.grow-it-organically.com/build-a-compost-pile.html.
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Figure 2.13 - Example of a three step compost bin. Nancy on the Home Front. https://nancyonthehomefront.com/how-to-start-a-compost-pile-at-home/. Accessed 22 July 2019.

Figure 3.12 - Photo of a Hummingbird visiting a Honeysuckle flower. Providence Journal. https://www.providencejournal.com/features/lifestyle/garden/20130705-diggin-in-hummingbirds-are-a-delight-for-the-eyes.ece. Accessed 12 August 2019.

Figure 3.13 - Photo of a Swallowtail Butterfly visiting a yellow flower. Beautiful Butterfly Pictures. http://www.ruangan.co/new-butterfly-pictures/.
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Figure 3.14 - Photo of a Honey Bee visiting a Sea Holly flower. Cobalt Wildlife. https://www.flickr.com/photos/cobaltwildlife/30890860277/.
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