2016

Advancing the Garden: Parking Lot Plan Planting Plan

Paige Ida
University of Pennsylvania

An independent study project report by The Alice and J. Liddon Pennock, Jr. Endowed Horticulture Intern (2015-2016)

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Disciplines
Horticulture

Comments
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INTRODUCTION

Upon arriving at the Morris Arboretum, the first horticulture display that visitors encounter is the garden spanning the perimeter of the Visitor's Center parking lot (Figure 1. Visitor Parking Lot). Unlike the permeable parking lot that has set a national precedent for sustainable design, the parking lot planting design lacks innovation. The existing herbaceous layer lacks year-round interest and requires inordinate maintenance. Due to its conspicuous location, the garden has the opportunity to feature a cohesive, effective planting design that is educational for Arboretum visitors. With major maintenance updates occurring in the parking lot during the fall of 2015, it was a logical time to reassess and update the surrounding garden.

The purpose of this project is to redesign the herbaceous level of vegetation in the Visitor Center's parking lot planting beds to improve functionality, provide visual interest, and introduce matrix design to the Arboretum. The first phase of the design (Figure 2. Phase One - Site Location) focuses on a design for full sun conditions. It was implemented and is being evaluated throughout the duration of my internship. Additionally, plant recommendations are provided for future phases that have different light requirements.

SITE ANALYSIS

Prior to redesigning Phase One, I analyzed the existing site conditions in the planting bed to understand the opportunities and constraints present on site. The findings are as follows:

Existing Vegetation: Besides *Caragana arborescens* and *Picea mariana*, the vegetative material was installed after the permeable parking lot was implemented in 1989. (R. Gutowski, personal communication, March 3, 2016). See Table 1. Existing Vegetation for a detailed list of existing vegetation. At the time of plant installation, the Arboretum had an abundance of wild collected specimens from expeditions to Korea that were suspected to be tolerant of salt and urban conditions. The parking lot beds were a logical location to trial their tolerance and showcase the collection (A. Aiello, personal communication, March 18, 2016). In the 1990's and 2000's, additional woody material was introduced to the site. The shrubs were arranged in monoculture groups throughout the planting bed. The arrangement of woody material currently lacks cohesion, which may have resulted from adding vegetation over several years without a definitive plan.

In addition to the woody material, there was an herbaceous layer of vegetation present on site. According to past gardeners, there was a high failure rate for plants ever since the planting bed was constructed (V. Marrocco, personal communication, October 26, 2015). Of the plants that survived, there was minimal diversity in the existing herbaceous species (see list below). The arrangement of the herbaceous vegetation presented an opportunity for annual and perennial weeds (see list below) to thrive as most of the groundcover layer was void of vegetation.

Existing Herbaceous Species: *Allium tuberosa* (garlic chives), *Amsonia tabernaemontana* (blue star), *Calamagrostis* x *acutifulora* 'Karl Foerster' (feather reed

grass), *Hemerocallis* 'Stella de Oro' (daylily), *Hosta minor* (hosta), *Iris* 'Caeser's Brother' (Siberian iris), *Iris lactea* (milky iris)

Existing Weed Species: *Cardamine hirsute* (hairy bittercress), *Cirsium arvense* (Canada thistle), *Oxalis* spp. (wood sorrel)**,** *Persicaria* spp. (smartweed), *Phytolacca americana* (common pokeweed), NETTLE

Light: The site primarily receives full sun with areas under the tree canopies receiving partial shade. As the planting bed is adjacent to the parking lot, the asphalt absorbs light and radiates heat. This creates a warmer microclimate, which can present a challenge for plantings during the peak of summer.

Topography: The grade surrounding the parking lot slopes away from it and it has a north aspect. As I observed in winter, the planting bed freezes and thaws unevenly. Areas that are closer to the parking lot and are level thaw earlier than areas that are further away and sloped. Due to the grading, water runs over the planting bed as sheet flow and either exits onto the lawn or enters a catch-basin within the planting bed. It will be important to monitor the installed plants to gauge their interaction with the movement of water as well as freezing conditions.

Soil: The high rate of plant failure led me to investigate the soil present on site by conducting a soil test. After collecting soil samples from a few locations throughout the planting bed, the sample was sent to The Pennsylvania State University – Agricultural Analytical Services Laboratory. The results listed the soil pH at 7.2, which is considered near neutral and optimal for landscape plants. The failure of the planting material may have resulted from selecting the wrong plants for the site conditions.

MATRIX DESIGN RESEARCH

In order to address the issues occurring in the parking lot planting bed, I redesigned the herbaceous level of planting material using a matrix design. Developed by European researchers within the past decade, matrix design is a planting technique that has been formulated for gardens within the public realm. This planting technique has been successfully applied to a variety of settings across Europe including public gardens, urban environments, and commercial sites (Schmidt, 2015). Recently it has been introduced to North America by Dutch garden designer Piet Oudolf, and used primarily in public gardens. After attending a lecture by Cassian Schmidt (director of Hermannshof Gardens) at the 2015-Perennial Plant Association Symposium, Compton Horticulturist Paul Orpello recommended introducing the style to the Morris Arboretum. Due to the principles of matrix design, the parking lot planting beds were an appropriate location to apply this design style.

Matrix design is centered on creating a dynamic plant community that requires low maintenance, which is achieved through the style of planting and plant selection. Unlike traditional planting design, matrix designs are laid out in a randomized, repetitive grid of plants (Oudolf & Kingsbury, 2013). Individual plants are spaced together at a higher density based on plant species, which allows them to grow together and form a community. The specific layout of the plants isn't critical to the functionality of the design; success stems from plant selection.

The plant palette used within matrix design is composed of species that fill five functional types (Schmidt, 2015), which are categorized by their ecological and aesthetic functions (See Table 2: Functional Types). 'Structural' plants are composed of tall, clump-forming plants that provide vertical interest in the design. 'Companion' plants add volume to the middle level of vegetation and are paired together to provide visual interest and movement throughout the garden. Annuals, biennials, and short-lived perennials are used as 'filler' plants. Filler plants add interest early in the lifetime of the garden, and later persist throughout the garden by self-seeding. As the garden matures, 'filler plants' will find less available room in the garden as the more permanent plants dominate the space. The 'groundcover perennial' layer accounts for the largest proportion of planting material, and has a low-growing, spreading habit. This layer is critical to weed suppression as it reduces the amount of barren soil. Finally, 'scattered plants' are typically bulbs dispersed throughout the planting that provide spontaneity and seasonal accents. Specific percentages are assigned to each of the five functional types, which reflect an idealized version of naturally occurring plant communities. In addition to fulfilling the functional types that create the plant community, plants are selected that thrive in the existing conditions on site (light, soil, climate), which reduces the amount of site preparation. By selecting plants that fill these specific niches, plants form an evolving community that supports biodiversity.

CASE STUDY: LURIE GARDEN

As part of my research for the project I visited examples of Piet Oudolf's matrix-planting design, which is utilized in perennial plantings within Chicago's 'Lurie Garden'. I met with Scott Stewart, Ph.D., the director and head horticulturist for the garden. My research goals included learning about the plant palette, the design of the garden, any challenges faced, and successful outcomes.

With over 3 million visitors a year, this 3-acre site is one of the most visited gardens in the United States. Prior to becoming a garden, the site was a train hub that was repurposed to be a parking lot. The parking still remains but has been relocated beneath the site in a parking garage, qualifying the garden as a rooftop garden. Designed by the landscape architecture firm Gustafson Guthrie Nichol, the design divides the garden into two contrasting plates that relate to the historical landscape of Chicago. The dark plate represents the mysterious wetlands that early settlers encountered. The light plate represents present-day Chicago and utilizes vibrant, prairie-inspired plantings that are back-dropped with the modern city skyline. A central boardwalk seam divides the two plates, and users experience the interface between past and present Chicago (ASLA 2008 Professional Awards, 2008).

Piet Oudolf was given free reign for the perennial design, and he created a four-season garden that utilized a block matrix design. Throughout the process, Oudolf collaborated with local expert plantsman Roy Diblik, and sourced most of the herbaceous material from his nursery, Northwind Perennial Farm. High biodiversity exists within the plant selection, and 240 perennials were incorporated into the design (GreenMark, 2016). The design includes a matrix foundation that is accented with seasonal interest plants, which are introduced as 'blocks'. An example of a block is the 'Salvia River', a purple ribbon composed of four cultivars of salvia that flows throughout the light plate. Each plant's appearance, flowering effects, growing habit, leaf

shape, and structure were considered to create the plant community. Plants were also selected for drought tolerance, pest resistance, and adaptability to the local climate, which reduces the amount of resources and input required (S. Stewart, personal communication, November 6, 2015).

For the design layout, Oudolf and Diblik marked individual perennial locations using color-coded stakes that represented the height of the plant species. The perennials were installed with double the distance of typical spacing, which allowed them to spread organically. Rather than plugs, plants were installed in a gallon size pot, which creates immediate visual impact. After planting, leaf mulch was added as a mulch to suppress the weeds. The immediate reaction to the Lurie Garden was mainly negative. The public was unsure of the installed design as it diverged from the instant gratification that is traditionally used within planting design today. The garden was viewed as a large swath of soil that lacked plant material, and the planting technique wasn't understood. However, once the perennial material matured in about five years after installation, it is regarded as an innovative display of sustainable horticulture (S. Stewart, personal communication, November 6, 2015).

In addition to being a dynamic horticultural display, the garden functions as an ecosystem. Within the planting selection, 80% are native to North America, and 60% of those plants are native to Illinois (GreenMark, 2016). By introducing 20% non-native species the plants have profuse flowers and a longer bloom time, which provides more food for pollinators throughout the year. An example is the combination of the native *Echinacea pallida* (pale coneflower) and *Echinacea* 'Pixie Meadowbrite' which is of horticulture origin. While *Echinacea pallida* blooms from June - July, *Echinacea* 'Pixie Meadowbrite' extends the bloom time from July - September. The plant diversity is maintained throughout the garden as the horticulturists edit the spread of aggressive species such as *Pycnantheumum muticum* (mountain mint) from outcompeting less aggressive species (S. Stewart, personal communication, November 6, 2015).

The sustainable maintenance of the garden provides wildlife habitat throughout the year. Rather than cutting down the perennials after flowering, the vegetative material persists throughout the year creating material for habitats. The dried seed heads provide food for birds and the flowers creates food for pollinators throughout the growing season. The plant material is cut down annually, which occurs between snowmelt and thawing. Hand tools are used to cut down larger grasses and vegetation, but the rest is harvested using a mower set at a height of 6 to 8 inches. The organic material is distributed evenly throughout the garden to decompose and enrich the soil. This method has proven to be effective as the initial organic material content was relatively low at 1%, but has increased to 4% after years of recycling plant material (S. Stewart, personal communication, November 6, 2015).

SITE DESIGN

Based on the site analysis, research of matrix design, and nursery availability, I compiled a plant list (Table 3. Plant List: Full Sun) and design (Figure 3. Phase One - Site Plan). As Phase One plantings were installed in late November, one of the project constraints was centered on plant availability. A few of the preferred perennials were unavailable, or not in the quantity that

was required to maintain the ratio of the functional types. After several revisions, I purchased 2,010 plugs from the nursery Kurt Bluemel, Inc. and 1,000 bulbs from Brent and Becky's Bulbs with a budget of $2,500.

The final plants selected meet the criteria and quantities for the five functional types that compose matrix design. Highlights within the structural layer include *Eryngium yuccifolium* (rattlesnake master) and *Panicum virgatum* 'Prairie Sky' (switchgrass). *Panicum virgatum* 'Prairie Sky' is the tallest plant in the matrix, and is composed of clumps of upright foliage with powdery blue blades that transition to tan in the winter. The finely textured flower panicles form an airy, burgundy plume that turns copper in the fall. *Eryngium yuccifolium* is an unusual-looking plant that features globular, greenish-white flowers on upright branching stems. The foliage consists of sword-like leaves that resemble yucca.

Achillea x 'Coronation Gold' (yarrow), *Echinacea pallida* (pale purple coneflower), and *Echinacea purpurea* (purple coneflower) are examples of companion plants that provide colorful, visual interest throughout the middle layer of the planting. *Achillea* x 'Coronation Gold' features fern-like, silvery foliage with long lasting mustard-yellow flowers that are held on stiff, upright stems. This hybrid withstands hot, humid summers and drought, making the parking lot beds an ideal location. Two species of coneflowers were selected to extend the overall bloom time, which was a technique used in the Lurie Garden. *Echinacea pallida* blooms earlier from June – July and has drooping, pale-purple petals with a spiny, coppery center cone. *Echinacea purpurea* flowers later into the season from June – September and has coarse textured leaves with a large, daisy-like flower head.

Monarda bradburiana (eastern beebalm) and *Persicaria amplexicaulis* 'Firetail' (mountain fleece) are vigorous perennials that spread throughout the garden. Laden with light pink flowers from May- June, *Monarda bradburiana* attracts wildlife including hummingbirds and pollinators. *Persicaria amplexicaulis* 'Firetail' has leathery, dark-green leaves and dense spikes of crimson flowers that persist from June – October. Both plants may need to be edited as the garden matures to prevent them from becoming the predominant species.

Despite contrasting appearances, *Sesleria caerulea* (spring moor grass) and *Sedum spurium* 'John Creech' (stonecrop) function as groundcover plants. *Sesleria caerulea* is a clump forming, cool season grass that slowly spreads. The grass is mainly used for its evergreen foliage that features bluish-green blades. Dark purple flower spikes appear early in the spring and fade to a light tan that persists throughout the season. *Sedum spurium* 'John Creech' forms a dense mat of foliage with small, scalloped green leaves. While the main function of the plant is to smother weeds through its spreading habit, attractive pink flowers appear above the foliage in the fall.

The scattered plants that provide seasonal interest include the perennial *Allium tanguticum* 'Summer Beauty' (ornamental onion) and two bulbs species: *Allium caeruleum* (blue globe allium) and *Allium sphaerocephalon* (round-headed leek). *Allium tanguticum* 'Summer Beauty' was recommended from the Lurie Garden as a 'bullet-proof ', four-season plant that withstands a variety of harsh conditions (S. Stewart, personal communication, November 6, 2015). The plant features glossy, dark-green foliage with lavender flowers from June-July. In fall the foliage turns yellow and the flower stems become reddish-brown. Both bulbs naturalize

freely throughout the garden, but provide different coloration. *Allium caeruleum* has a 1-2inch sphere that is a cluster of blue star-shaped flowers during June. *Allium sphaerocephalon* provides color longer from May-July with flowers that start green and transition to a reddish-purple.

INSTALLATION

Prior to installation in late November, the site for Phase One Plantings was prepared through the removal of select vegetation and weeds. Due to its historical significance, the majority of the shrub layer was to remain (Table 1: Existing Vegetation). Two *Vitex agnus-castus* (chaste tree) were removed that were in poor condition along with a dead *Vitex negundo* (Chinese chastetree). The remaining *Vitex* species were pruned to reduce their size and promote healthy growth patterns. *Rosa* 'MElzmea' (Carefree Spirit™) shrubs were relocated to the adjacent staff parking lot and incorporated into the existing planting bed. With the expertise of Paul Orpello, the backhoe was used to remove the undesired shrub specimens, which was an effective method as it reduced the amount of manual labor required. Stubborn perennials, such as *Amsonia tabernaemontana,* were extracted using a skid-steer and the rest of the herbaceous material was removed manually with a shovel. The material was loaded into the dump truck and several loads were disposed of in the compost pile.

It is ideal to minimize the amount of soil disturbance as it creates an opportunity for weed seeds to establish (Diblik, 2014). However, once we compared the size of the perennial plugs to the existing weeds we decided that it was necessary to till the weed layer. As the majority of the plugs were dormant for the season, it would be difficult to recognize the plugs among the weeds when installing the plugs. Additionally, the new perennials would have to out-compete the established perennial weeds, which could compromise the success of the perennials. Using a large rototiller, I tilled the majority of the site. A small rototiller was used to detail areas around preserved vegetation and the stone block edging that separates the planting bed from the parking lot. Weeds located under the preserved shrubs were hand weeded to minimize damage to their structure and root system. The site was smoothed out using a hard rake to remove weed debris and level out the soil. Finally, Preen was sprinkled throughout the planting bed, which will prevent new weeds from growing.

Once the site was prepared, the matrix design was laid out. With the help of horticulturist Lucy Dinsmore, we spent four hours hand-placing each plug. Our method consisted of laying out each species entirely to evenly disperse them throughout the planting bed. Although the overall design of the matrix is mixed, we were constrained by the edge adjoining the parking lot. Large, structural plants were located throughout the center of the bed to prevent them from extending into the parking lot stalls, and we placed plants with a smaller growth habit near the front edge. Flowering companion plants were laid out in loose drifts to achieve greater visual impact throughout the season. The remaining plants were interwoven throughout the staged plugs to have even coverage throughout the bed. With a team of 14 Morris Arboretum employees, the plugs were efficiently installed in 2 hours. Hard- to- see perennials were flagged using marking flags. The bright flags made the perennial location apparent, which was important for performing garden maintenance and monitoring the new plantings. Finally, the two bulbs species were hand scattered throughout the planting bed and installed.

Protection for the new plantings was necessary due to the location of the bed, pressure from pests, and weather conditions. Immediately after installation, a fence created with wooden stakes and twine was installed around the perimeter of the planting bed to deter visitors from entering and damaging the plantings. Liquid Fence was applied around the perimeter of the planting bed to repel deer and groundhogs from eating the new perennials.

OBSERVATIONS

The perennials and site conditions were observed and maintained from installation in late November 2015 and will continue until the end of the internship in June 2016. As the plants were dormant upon installation, there wasn't any noteworthy growth throughout the fall and winter. Once the temperatures reached freezing, the plugs began heaving due to the freezing and thawing of the soil. With a recommendation from chief horticulturist Vince Marrocco, a ¼ inch layer of compost was spread over the installed plants. The added insulation reduced the amount of heaving initially, but as the winter progressed the plugs were both partially and fully ejected. Throughout the winter and spring I routinely pushed down the plugs and replanted the ones that had dislodged.

There were a couple of notable disturbances in the parking lot. Although repellent was applied, the deer have not been deterred and have a prominent trail that crosses through the bed and enters the garden. However, the deer have not disturbed the plantings and it won't be a concern unless they begin browsing on the vegetation. During the major blizzard of January 2016, snowplows piled snow along the western side of planting bed. The edge of the planting bed was scraped, and the plugs were dislodged. The plugs were replanted and the impact will be observed in the spring.

With a mild winter, the herbaceous material had observable growth as early as January, and more species were present as the growing season progressed. The first species to flush out new foliage was *Achillea* x '*Coronation Gold'* and it has rapidly expanded in size. The two bulb species, *Allium caeruleum* and *Allium sphaerocephalon,* emerged in January along with additional bulb foliage from the previous plantings. Once identifiable, the existing bulb species will be evaluated and may face removal. The cool season grass *Sesleria caerulea*, maintained its evergreen foliage throughout the winter. In mid-February, *Eryngium yuccifolium* had new light green crowns emerge through the old foliage. The reddish-green leaves of *Sedum* 'John Creech' began expanding as the groundcover showed signs of its typical growth pattern. By March over half of the herbaceous material showed signs of growth. *Echinacea pallida* and *Echinacea pupurea* had sharp, red shoots rising vertically through the growth. New growth of *Monarda bradburiana* featured greenish-purple leaves held on multiple stems up to 4 inches in height. *Salvia nemerosa* 'Ostfriesland' had clusters of rough, grey-green leaves. The first warm season grass to emerge was *Sporobolus heterolepis* with slender blades protruding through the tan old growth. As the growing season continues the success of the remaining perennials will be evaluated. In the event that a species doesn't return, it will be replaced with a perennial that fulfills its functional type.

In addition to the desired species, weeds have started to emerge in areas that were hard to clear initially. Weed suppression is critical and must be performed regularly at specific intervals

early in the growing season and reduced as the season progresses. While the plants are starting to emerge, hand weeding is preferred as the vegetation is hard to identify. Once the perennials have established, a push-hoe is an effective tool for weeding as it destroys juvenile weeds without disturbing desired plants, and covers a large area of ground quickly. Additionally it reduces back strain as users stand vertically while using a pushing and pulling motion. By keeping up with the weeds, it will allow the perennials to mature with less competition.

FUTURE RECOMMENDATIONS

Similar to the Phase One, the future phases focus on the herbaceous material found in the perimeter planting beds of the Visitor Center's parking lot. The shape of the existing planting beds is to remain, but unhealthy shrubs and undesired herbaceous material will be removed. Due to the light conditions, a shade matrix (Table 4. Plant List: Shade) has been recommended. Successful existing material including *Liriope platyphylla*, *Helleborus viridis,* and *Heuchera micrantha* 'Palace Purple' will become incorporated into the matrix.

After the gardens have been established, educational signage near the gardens will provide visitors with information on matrix design. As this style has recently been introduced to North America, it is important to clearly provide information on the planting design and benefits of utilizing this technique. As observed in other areas of the gardens, visitors are curious about plants that are successful and showy. Due to the high level of traffic through the parking lot, this garden will be no exception. A graphic highlighting successful plants for each matrix is beneficial for visitors that want to install a design of their own.

CONCLUSION

The redesign of the herbaceous layer of vegetation in the Morris Arboretum parking lot beds addresses reoccurring issues and created an attractive first impression to visitors. By selecting plants that fulfill the functional types of matrix design, Phase One provides year round interest, lower levels of maintenance, and important ecological habitat. Through the implementation of Phase One, a precedent has been established to continue the future phases for the rest of the parking lot beds.

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I would like to thank the following individuals that helped throughout the course of the project. First, I would like to thank my supervisor Paul Orpello, for providing extensive knowledge while making the project meaningful and enjoyable. Elinor Goff provided appropriate files for the site plan basemap in a timely fashion. Anthony Aiello, Robert Gutowski, and Vincent Marrocco provided historical first-hand knowledge of the site, which helped inform design decisions. Finally, a warm thanks to the following volunteers that installed the first phase of the garden: Lucy Dinsmore, Victoria Bolden, Grant Folin, Willa Rowan, Tracy Beerley, Chris Engel, Maya Czulewicz, Kate Deregibus, Joshua Best, Bryan Thompson-Nowak, Brian Sidelinker, and Nikki Beadle.

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TABLES

Table 1. Existing Vegetation

PHASE ONE: EXISTING VEGETATION				
1930				
Accessioned	**Scientific Name**	**Common Name**	**Quantity**	**Removed**
1932	Caragana arborescens	Siberian pea tree	1	
1934	*Picea mariana*	black spruce	1	
1980				
Accessioned	**Scientific Name**	**Common Name**	**Quantity**	**Removed**
1981	*Koelreuteria paniculata*	golden rain tree	2	
1981	*Pinus koraiensis*	Korean pine	2	
1986	*Viburnum bitchiuense*	Bitchiu viburnum	4	
1986	*Viburnum dilatatum* f. *pilosulum*	linden viburnum	1	
1986	*Sorbus alnifolia*	mountain ash	1	
1986	*Pinus densiflora*	Japanese red pine	2	
1986	*Pinus densiflora x thunbergii*	pine hybrid	1	
1989	*Cornus officinal*	Japanese cornelian cherry	1	
1989	*Picea orientalis*	oriental spruce	1	
1990				
Accessioned	**Scientific Name**	**Common Name**	**Quantity**	**Removed**
1992	*Rhododendron micranthum*	manchurian rhododendron	1	
1992	*Rhododendron mucronulatum* var. *ciliatum*	fringeleaf Korean rhododendron	10	
1994	*Vitex negundo*	Chinese chaste tree	4	1
1994	*Elaeagnus macrophylla*	oleaster	2	
1996	*Viburnum schensianum*	shensi viburnum	3	
1997	*Syringa wolfii*	Wolf's lilac	1	
1997	*Vitex agnus – castus*	chaste tree	6	5
2000				
Accessioned	**Scientific Name**	**Common Name**	**Quantity**	**Removed**
2000	*Rosa* KNOCK OUT	shrub rose	Mass	x
2002	*Iris lactea*	milky iris	Mass	
2002	*Koelreuteria paniculata*	golden rain tree	1	
2005	*Koelreuteria paniculata*	golden rain tree	1	
2007	*Callicarpa mollis*	Japanese beautyberry	3	
2010	*Rosa* 'MElzmea'	Carefree Spirit™	Mass	Moved

Table 2. Functional Types

FUNCTIONAL TYPE	PERCENTAGE	HEIGHT	DESCRIPTION
Structural	10-15%	> 28"	Tallest plants, mainly clump forming, show structural aspect over a long period
Companion	30-35%	16 - 28"	Medium height plant
Filler	5-10%	N/A	Short-lived perennials or biennials, infill free spaces at the beginning and later self-seed
Ground-Cover Perennials	Up to 50%	< 16"	Lower growing plants with spreading habit
Scattered Plants	Additional proportion	N/A	Dotted throughout the area, mainly bulbs

Table 3. Plant List: Full Sun

STRUCTURAL PERENNIALS (10-15%)	COMMON NAME	HEIGHT	BLOOM TIME	BLOOM COLOR
Aster novae-angliae 'Alma Potschke'	New England aster	3 - 4'	June - September	Rose-pink, yellow centers
Eryngium yuccifolium	rattlesnake master	4 - 5'	June - September	Greenish-white
Kniphofia uvaria 'Flamenco'	red-hot poker	2 - 3'	June - August	Fiery yellow, orange, red
Panicum virgatum 'Prairie Sky'	switchgrass	4 - 6'	August - February	Dark red
COMPANION PERENNIALS (30-35%)				
Achillea x 'Coronation Gold'	yarrow	2.5 - 3'	June - September	Yellow
Echinacea pallida	pale purple coneflower	2 - 3'	June - July	Pale purple
Echinacea purpurea	purple coneflower	2 - 3'	June - September	Purplish-pink
Pennisetum alopecuroides 'Cassian'	dwarf fountain grass	2 - 2.5'	August - October	Whitish-green with pink tinge
Sporobolus heterolepis	prairie dropseed	2 - 3'	August - October	Pink and brown-tinted
Stachys monieri 'Hummelo'	betony	1.5 - 2'	June - September	Red-purple
FILLER PLANTS (5-10%)				
Monarda bradburiana	eastern beebalm	1 - 2'	May - July	Pinkish-white with purple spots
Persicaria amplexicaulis 'Firetail'	mountain fleece	3 - 4'	June - October	Dark red
Scutellaria incana	hoary skullcap	2 - 3'	June - September	Blue
GROUND COVER PERENNIALS (50%)				
Salvia nemorosa 'Ostfriesland'	meadow sage	1 - 1.5'	June - September	Purple
Sedum spurium 'John Creech'	stonecrop	0 - 3"	August - September	Pink
Sesleria caerulea	spring moor grass	12 - 14"	April - June	Dark purple fades to light tan
Stokesia laevis	Stokes' aster	12 -18"	June - September	Blue with white center
SCATTERED PLANTS				
Allium tanguticum 'Summer Beauty'	ornamental onion	18 - 24"	June - July	Pinkish - lavender
BULBS				
Allium caeruleum	blue globe allium	1 - 3'	June	Blue
Allium sphaerocephalon	round-headed leek	20 - 24"	May - July	Red-purple

Table 4. Plant list: Shade

STRUCTURAL PERENNIALS (10-15%)	COMMON NAME	HEIGHT	BLOOM TIME	BLOOM COLOR
Chasmanthium latifolium	northern sea oats	2 - 4'	August - September	Green
Tricyrtis formosana 'Samurai'	toad lily	12 - 18"	August - September	Violet blue
Aster cordifolius 'Avondale'	blue wood aster	2 - 3'	September - October	Blue rays and yellow center
COMPANION PERENNIALS (30-35%)				
Astilbe chinensis 'Visions'	Chinese astilbe	1 - 1.5'	July - August	Pink
Carex pensylvanica	Pennsylvania sedge	8 - 12"	April - May	Yellow & light brown
Hosta 'Halcyon'	hosta	1.5 - 2'	August	Lilac-blue
Helleborus Winter Thriller™ 'Grape Galaxy'	lenten rose	18 - 24"	Dec - March	Purple
FILLER PLANTS (5-10%)				
Begonia grandis	hardy begonia	1.5 - 2'	July - October	Pink
Bergenia cordifollia 'Winterglow'	pigsqueak	1 - 1.5'	April - May	Magenta
Thalictrum dioicum	early meadow rue	18 - 24"	April - May	Greenish-white
GROUND COVER PERENNIALS (50%)				
Hakonechloa macra	hakone	1-1.5'	July - August	Yellowish-green
Heuchera villosa 'Autumn Bride'	alumroot	10 - 14"	August - October	White
Euphorbia amygdaloides var. *robbiae*	wood spurge	12 - 18"	April - May	Yellowish-green
BULBS				
Chionodoxa forbesii	glory of the snow	5 - 8"	March - April	Blue with white center
Fritillaria meleagris	snake's head fritillary	8-12"	March - April	Magenta

FIGURES

Figure 1. Visitor Parking Lot

Figure 2. Phase One - Site Location

Figure 3. Phase One - Site Plan