FOUR MEADOWS AT TWO SWALLOWS: CREATING AND MANAGING A NATIVE MEADOW AESTHETIC WITHIN A WORKING AGRICULTURAL LANDSCAPE ON THE GEORGIA PIEDMONT

by

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(Under the Direction of Sarah Georgia Harrison Hall)

ABSTRACT

This thesis proposes a realistic model for establishing and maintaining designed meadow landscapes in the context of the rural Georgia Piedmont. Climate and soil characteristics specific to the Southeast bring unique challenges not seen in similar projects in other regions, especially with parallel goals of animal habitat and aesthetic interest. The rich history of Southeastern grasslands presents opportunities to use rare and endemic herbaceous plant species to create landscapes that speak to the significance of place and biodiversity of the region. Imparting design intent and using land as art form takes on a distinct appearance amongst a working agricultural landscape. Using underutilized spaces to create meadows on working agricultural landscapes proposes an expanded concept of “productivity,” as it also applies to invertebrates and indirect ecosystem services. The goal of this research and design is to create practical meadow typologies applicable to the working agricultural landscape that now dominates the rural Piedmont landscape.

INDEX WORDS: landscape architecture, native meadow, pollinator habitat, southern Piedmont, agricultural landscape design, native grassland communities

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DEDICATION

For Marla Jane Norton, who taught me to be curious and creative. You made this and every opportunity possible.

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Chapter 1

Introduction

Description of Topic

Native Southeastern grasslands are ecologically rich. An aesthetic design approach that revives designer's interest in grasslands through species composition and management in a commonplace, working Piedmont landscape is an effective tool for realizing the myriad benefits of diverse natural systems.

Although post-settlement European land use practices all but erased savanna-like landscapes from the American Southeast, they once covered large portions of the southern Piedmont. Descriptive historical information documents the abundance of Southeastern grasslands, yet much less is known about their species composition and management, (or lack of management) when compared to similar historical landscapes in other regions of the Eastern United States.

This thesis proposes to investigate the steps necessary to create and manage designed Piedmont meadows within an agricultural landscape in the Southeast, using a projective design approach and applying a series of theoretical questions to a specific site. The meadow design application involves planning and siting a new farm manager's house at Two Swallows farm in Madison County, GA. This serves as a suitable application because the owners prioritize native grassland planting design. Beyond aesthetic preferences, this approach benefits food crops through invertebrate pollinators, is low-maintenance, and aids ecological function of soils and adjacent agricultural pastures in diverse ways. Two Swallows is a 135-acre working farm with mixed hardwood and open pastures for livestock, offering a variety of site conditions and implementation challenges.

The objective of this study is to propose and evaluate the implementation and management of four detailed typologies of designed Piedmont meadows: "Upland Sun," "Swale

Sun," "Partial Shade," and "House Envelope." The four typologies were developed after much time spent at Two Swallows in the previous three years, experiencing the range of weather and seasonal conditions, and range of grassland habitat characteristics throughout the farm. Distilling these varying habitats into four typologies allows for a site-appropriate species composition, while also creating a simple guide that can be applied to all areas of the farm. Each typology has a unique species composition, aesthetic goals, and management regimes. The primary assessment metric within the scope of this thesis is intended to focus on the aesthetic, so to meet the expectations and sensibilities of the client, the majority of research is focused on management regimes that will lead to meadows comprised of multi-season, showy native herbaceous grasses and forbs. By referencing existing literature on the history of Southeastern grassland communities and noting an emerging American and European preference for them as a functional and aesthetic design approach, the many challenges to the design and ongoing management of the grassland landscape element will be explored. Case studies from similar sites in the Southeast aid in determining successful and unsuccessful design and management approaches for designed meadows, yet few offer specific strategies for sites within a working agricultural landscape in this geographic region. In a practical way, this research will contribute insight into the establishment and implementation challenges of a designed Piedmont meadow in the Georgia Piedmont.

Methods

In order to understand specific composition, function, and aesthetics of designed meadows on the Georgia Piedmont, first it is necessary to examine the ecological history of Piedmont grasslands, and uncover the many reasons this typology is desirable as a design tool in an agrarian landscape. Research will examine human preference for meadow landscapes, aesthetic qualities, ecological function, management regimens, and the significance of cultural impact on the appearance of these designed grasslands.

Next, three applicable case studies examining establishment techniques, management plans, and range of aesthetic intent will be used to influence the projective designs at Two Swallows farm. These case studies, along with literary research and information from current practitioners, will inform each site design and management plan.

Applications

The application of this research is a projective design and management program for a designed meadow landscape at Two Swallows Farm near Comer, GA. The design and management program will consider four detailed typologies for the implementation and management of designed Piedmont meadows: upland sun, swale-sun, partial shade, and the perimeter of an existing building envelope. All four typologies are present within the Two Swallows site, with unique species composition, aesthetic goals, and management regimes for each.

Need for Research

Designed meadows are increasingly prevalent in both urban and rural designed landscapes. Aesthetic interest, dramatically decreased landscape maintenance, and the significant role these plant communities play in ecological systems' function are just a few of the attractions to this aesthetic. With a surge in popularity of these landscapes, professional landscape architecture firms, (Oehme, van Sweden & Associates; Larry Weaner Landscape Associates; W.M. Whitaker and Associates; Nelson Byrd Woltz) are perfecting seed mixes, planting methods, establishment techniques, and maintenance practices for designed grasslands and meadows comprised primarily of native warm season grasses (NWSG) and non-woody herbaceous forbs.

Despite a well-documented descriptive history of savanna-like grasslands throughout the American Southeast, few examples of successfully implemented and maintained meadows are acknowledged among the design or ecological restoration community today. This is due to a variety of cultural and natural factors, but pernicious invasive weed species, greater average annual rainfall, and an extended growing season contribute to the difficulty of maintaining meadow landscapes. Additionally, a cultural perception persists of the American Southeast as historically being an unbroken forest, with little or no natural grasslands. This research will revisit the history of the Piedmont Savanna, along with our natural human preference for these landscapes.

Beyond preference and historical accuracy, the ecological need for meadow landscapes in rural areas has been established but seldom addressed because of the seemingly unbroken habitat compared to urban areas. Though pollinator habitat may seem lacking in towns and cities, ornamental plantings, diverse tree species and food gardens offer diverse habitat in numerous small patches. In contrast, meadows and existing grasslands on the rural Georgia Piedmont are dominated by undulate forage and row crop production, resulting in near - monocultures outside of roadside remnants, powerline easements, and occasional food gardens. This lack of habitat has contributed to dramatic declines of native pollinator species, most of which have a flight range of less than 2 miles and many under 0.5 miles. With two-thirds of all crop varieties dependent on annual animal pollination, increasing rural habitat for invertebrate pollinators is critical. It is in these habitat patches - in powerline easements, food gardens, and remnant habitat connectors - that the potential for reestablished grasslands exists.

Finally, as non-agricultural residents settle in formerly rural agricultural lands, they bring with them conceptions of landscape that are increasingly “cultural,” indicating increased intention and ornament, and abandoning the “wild unpredictability” of the country. As our communities grow and agricultural land is increasingly intermixed with rural residential, landscape architects have a critical opportunity to increase aesthetic and ecological benefits of the rural landscape. It is also important to encourage successful cases of designed meadows on the Southern Piedmont of Georgia, as most of the contemporary literature and case studies focus on applications north and west of this region. Due to an extended growing season, significantly greater rainfall, and invasive species encouraged by both, applying principles of a designed meadow in the context of the Georgia Piedmont creates management challenges not faced in the American Northeast, Midwest, or Western Europe.

Research Question

What are design and management challenges for landscape architects when designing a stress-tolerant "dry meadow" with multi-season aesthetic interest on the Georgia Piedmont within a working agricultural landscape?

Secondary Questions

1. What is the most effective species composition for a stress tolerant meadow on the Georgia Piedmont that benefits both pollinators and a working agricultural landscape?

    How does species composition vary between sites: upland, roadside swale, forest edge / ecotone, and near structure sites?

    For grazers and invertebrate grazers: how do designed meadows increase stability and productivity of agricultural landscapes, especially with competing interpretations of productivity.

2. How can designed meadows increase/fulfill aesthetic values of landowners while reducing maintenance and input costs? (Mechanical/physical and cultural practices)

    Increased investment in a designed landscape should not require increased maintenance.

    How are perceptions of pleasing landscapes dependent on cultural contexts? (rural vs. urban)

3. How is aesthetic value maintained and how are management practices unique to this specific region?

4. What are practical application techniques of designed perennial meadows on smaller pieces of land than those generally seen in practice (smaller sites than London's Olympic Park or other large prairie sites?).

> There is an advantage in filling mini-habitat niches throughout an agricultural landscape while preserving large pieces of land for crop and animal production.

5. What, if any, culturally significant or endemic plant species should be included in the seed mix?

Context

The environment for this thesis is the Upper Piedmont of Georgia, in the American Southeast. More specifically, the projective design site is at Two Swallows farm, less than a mile south of the Broad River in northeast Madison County.

Limitations

This research focuses on one site in Madison County, Georgia. Most existing research on remnant Piedmont prairies and designed meadows is done in more northern sites, in Tennessee, North Carolina, and Virginia. Soil types and annual rainfall amounts are similar, but temperature and invasive species prevalence vary widely. This study will attempt to use case studies close to the Two Swallows farm site, both physically and culturally. However, this may result in a case study referenced farther from Madison Co, GA if it contains better establishment and management records and similar plant communities.

The time frame of this research limits the ability to implement the projective design for each of the sites at Two Swallows. Case studies and substantial research and experience from similarly designed landscapes enable this project to provide a detailed step-by-step process for seed selection, implementation and management.

Changing climate conditions may limit the future applicability of this study and its prescriptions, as both native and non-native plant species may begin to colonize new territory and retreat from long-held, familiar habitat.

Delimitations

This study is concerned with establishing designed meadows in four different habitats on Two Swallows farm. As part of the study, portions of the farm will be described, mapped and depicted as they are relevant to any of the four habitat typologies, however this is not a farm master plan. The procedures produced in this research are applicable to similar sites in the region, yet each designed meadow site is unique and should be approached with science, intuition, and art.

Chapter 2

Piedmont Savanna History

Southeastern Grasslands

In advocating for a design model that speaks to a historic native grassland community in the Southeast it is important to distinguish between several terms for this typology: “prairie,” “savanna,” “meadow,” and simply “grassland.” These are all used to describe landscapes composed mainly of grasses and forbs, more or less interrupted by trees and shrubs (Cole, 1986). “Prairie” is often associated with deep, rich soils in the Mississippi and Missouri Valley, however many writers refer to southern outcrops throughout Mississippi, Alabama and Georgia as "black belt prairies." “Meadow” has fewer associations specific to the Midwest and more with low-lying, cleared areas in proximity to agricultural uses. Its increasing use within the landscape architecture profession to describe a designed and intentionally managed landscape will be continued here. In *Forgotten Grasslands of the South,* Reed Noss opts for Dr. Cecil Frost’s straightforward definition: “A grassland is any community in which the grass layer, with its associated forbs, is the dominant layer in terms of either total cover or biomass or both” (2013).

While the term, “savanna,” originally described a land “without trees but with much grass either tall or short,” a broader definition in the late nineteenth century included grassland with trees (Cole, 5). “Savanna” is often a better descriptor of Southeastern grasslands, interrupted by trees and shrubs with 10-15% canopy. In some cases the tree canopy is even greater. Most would consider a virgin longleaf pine – wiregrass community near Thomasville, Georgia a forest or woodland, yet a vast majority of the species reside in the grass-dominated groundcover, where most of the crucial ecological processes operate (Noss, 2013). While canopy cover in the longleaf pine – wiregrass community nears 60 percent, an “ecosystem may be designated as grassland when the canopy of grasses is continuous or nearly so” (Noss, 2013, 9).

Patchwork Prairies

Unlike a completely unbroken forest, the Southern Piedmont could be described more as a "patchwork of adjacent, dissimilar communities with often indistinguishable boundaries between them" (Juras, 28, 1997). William Bartram's vivid description of the presettlement Southeastern landscape included grasslands among the patchwork. In describing the area west of the Oconee river in the Georgia Piedmont, he writes of "…a pleasant territory, presenting varying scenes of gentle swelling hills and levels, affording sublime forests, contrasted by expansive illumined green fields, native meadows and Cane breaks" (Bartram, 307). A presettlement Piedmont meadow might closer represent the image below of Harrell Prairie, in Scott County, Alabama.

Fig.2.1. Harrell Prairie in Scott County, Mississippi

Harrell is part of the extensive, disjunct physiographic region known as black belt or blackland prairies throughout Mississippi, Alabama and small portions of Georgia. The name refers to the fertile, calcareous shrink-swell clay soils generally uncharacteristic of the Southeast that result in extensive grasslands more reflective of the Midwest. (Echols & Zomlefer, 2010). Unlike the Midwest, these unique soil outcrops and their erratic distribution across the Southeast have encouraged and harbored the development of endemic taxa.

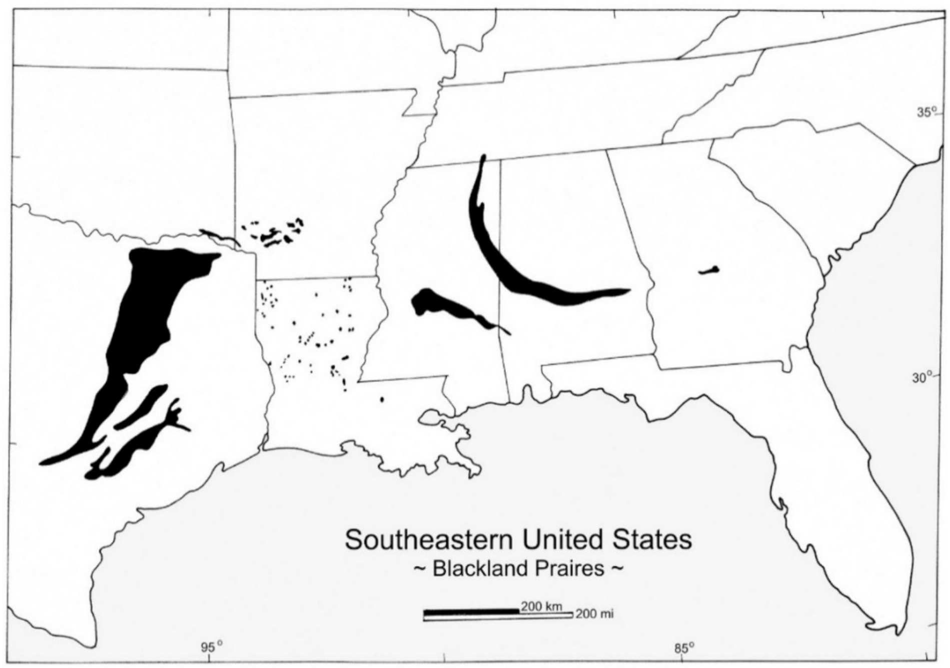

Fig.2.2. Locations of Blackland Prairies in the southeastern United States

Locally known as “cedar fields” in Mississippi and Alabama, this black belt prairie in Dallas County, Alabama (Fig: 2.3) appears as a pasture being invaded by cedars, though a closer look reveals dominance by several classic prairie grasses and forbs (Noss, plate 9, 2013). The calcareous soil and shrink-swell clay soils are the primary factors prohibiting timber growth, as the soil is devoid of oxygen when saturated, and lacks structure when dry (Echols and Zomlefer, 2010).

Fig.2.3. Old Cahawba Prairie in Dallas County, Alabama

Like Harrell, Old Cahawba Prairie in Dallas County, Alabama (Fig.2.3) is also an upland / calcareous black belt site, and home to highly endemic prairie species. *Silphium perplexum,* or Old Cahawba Rosinweed, (Fig. 2.4) below is considered extremely rare throughout its range, and currently all known populations are within 13.5 km of the Cahaba River (Barger, 2014). Beyond many descriptive historical accounts, highly endemic species like *Silphium perplexum* provide evidence of the antiquity of Southeastern grasslands.

Fig.2.4. *Silphium perplexum* (Noss, plate 10)

The individual size of unbroken open grassland savannas was historically smaller in the Southeast, although it was extensive, with much greater species richness. Greater isolation leads to greater specialization to niche habitats, and the table below demonstrates enormous species richness due to narrow distribution. Noss' Table 1.1 shows species numbers among five prairie plant genera common to the Prairie region (the Great Plains and Midwest) compared with the South (Noss, 2013). The 5-10-fold increase in species demonstrates the enormous biodiversity not just throughout the Southeast, but the potential biodiversity possible on smaller sites, not possible in the Prairie region.

	Prairie region	South
Andropogon (big bluestems)	2 spp.	19 spp. in Florida 16 spp. in North Carolina 11 spp. in Louisiana
Sorghastrum (Indiangrasses)	1 sp.	4 spp.
Schizachyrium (little bluestems)	1 sp.	10 spp. in Florida 3 spp. in North Carolina 5 spp. in Louisiana
Liatris (blazing-stars)	10 spp.	14 spp. in Florida 12 spp. in North Carolina 5 spp. in Louisiana
Echinacea (purple coneflowers)	3 spp.	9 spp.

Fig.2.5. Southern species richness of Prairie Region genera

Native warm season grasses such as *Andropogon, Sorghastrum,* and *Schizachyrium* seen above are the most abundant species of any American grassland, and their rich diversity in the South is further evidence of historic Southeastern grasslands (Cole, 7, 1986).

Countering the Unbroken Forest Myth

Describing the distribution and unique characteristics of Piedmont savannas is important in understanding the historical existence and importance of native Southeastern grassland communities. The misperception of the undisturbed Southeast as an unbroken forest ignores human involvement and is far different than the Piedmont landscape of 300 years ago. Ignoring Euro-American fire suppression and post-Depression agriculture land abandonment have focused perceptions on the old field successional forest composition familiar in the last century (Skeen, Doerr, and VanLear, 27).

Prior to European settlement, many explorers to the Piedmont region such as Bartram and Benjamin Hawkins gave descriptive evidence of grasslands in this region. Many of these same explorers written accounts attributed cleared land to Native American - caused fires. Whether for “rousing game,” attracting game to new growth following fires, insect control, ease of travel, or line of sight against attack, Native people had many reasons for clearing land (Bartram, 363).

Although, the proportion of fires caused by Natives versus those caused by lightning, or other weather related activity such as hurricanes, is not known. There are more lightning strikes in the Southeast than any other region in the United States, but explorers mentioned lightning-caused fires far less than “Indian burning” (Juras, 1997). Though it is probable that Native people routinely used and maintained cleared lands, only indirect evidence regarding the frequency and causes of fires exists, and it is difficult to attribute disturbance regimes to non-human or anthropogenic causes (Cowell, 138).

Historically, the American Southeast was far from an unbroken forest, yet, relatively young secondary forests covering most of the modern Piedmont allow assumptions of what “nature” would have done, left alone and allowed to return to the undisturbed state of climax forest (Juras, 1997). Even excluding frequent human disturbances, climate, fire history, soil characteristics, grazing pressure, and “an element of chance” all suppose the presence of grassland in a certain place (Ripley, 1991). Piedmont grasslands did exist, and the “tens of millions of acres of grassland in the South at the time of EuroAmerican settlement” were distinct from Prairie region counterparts.

Rather than simply existing where there is too much rain for desert, but not enough rain to support forest, Southern grasslands are a result of disturbance, topography, soil characteristics, and grazing pressure. Habitat isolation and the disjunct plant communities have led to a less visible, but exponentially more diverse and distinct community of endemic and classic prairie species. The myriad of factors and relatively small size have made Southern grasslands among the most biologically rich ecosystems on the planet, especially for herbaceous plants (Noss, 11, 2013).

Making visible plant communities and culturally invaluable species is important for restoration and preservation of remaining undisturbed Southern grasslands. In structuring a projective design based on native, resilient species, it is important to recognize the authenticity and antiquity of Southeastern grasslands. However, the goal of this thesis is not to reconstruct a

Piedmont savanna. It is not a southern savanna or blackland prairie re-construction, but a re-creation based on historic influences and a distinct southern meadow aesthetic. In re-creating these southern meadows, historically – present species and species of aesthetic interest are used to create a culturally specific designed landscape.

Highlighting the importance of both common and rare native grassland species, and their importance in contemporary designed landscapes is one goal of this thesis. Promoting the design impact of native grassland species and introduced species of horticultural interest will enrich resilient planting designs and correctly reflect the culture and significance of place.

Chapter 3

Preference as a Design Tool

Human preference for savanna-like landscapes is well researched, (Jay Appleton, Paul Gobster, and Rachel and Stephen Kaplan) and nearly unavoidable in daily life, from the lawns and trees of suburbia, to pastoral public parks, orchards, and private estates. Landscape legibility and prospect-refuge theory go far in describing human's basal attraction to these landscapes beyond what seems subjective aesthetic pleasure. But, aside from bioevolutionary preference, this aesthetic has many practical reasons to be encouraged as a design tool, especially amongst a working agricultural landscape.

Evolutionary Preference

The success of any species is dependent on its ability to collect and respond to information about the surrounding environment. The human need to be immediately aware of the environment and gather as much information as possible is reflected in our propensity towards legible landscapes that allow for travel, foraging, and anticipation of threat.

As pre-humans developed the ability to exist not just in trees but in the more dangerous world on open ground, they acquired a balance of flight responses with new fight responses necessary for life as a ground dweller (Kaplan and Kaplan, Humanscape 10-13). Savanna-like landscapes offer relative ease and fewer stress threats related to predation and navigation. In Jay Appleton's seminal *Experience of Landscape* his Habitat Theory proposes a relationship between man and the landscape whereby man "being at risk as soon as they were born into the world, reduced the danger of premature extinction in proportion as they knew how to use their environment to further their biological needs" (Appleton 76, 1975). More than merely for ease of foraging and travel, humans have always been drawn to savanna-like landscapes out of necessity.

It is from this remembered sense of unease and disturbance, or ease and satisfaction, that our aesthetic reactions depend (Appleton, 1975).

Appleton's widely known, studied, and scrutinized prospect refuge theory supposes at its core that concurrent opportunity and safety, or "seeing, without being seen" forms a basis for not just species survival, but aesthetics. Addressing the most basic needs of survival, Appleton writes that "because the ability to see without being seen is an intermediate step in the satisfaction of these needs, the capacity of an environment to ensure the achievement of this becomes a more immediate source of aesthetic satisfaction" (73) He is simply stating that out of necessarily remembering what we need to satisfy needs, we quickly remember positive environmental responses in reaching that goal.

Paul Gobster's 1994 article "The Urban Savanna: Reuniting Ecological Preference and Function" brings this theory to the present day, attempting to evaluate public perceptions of ecosystem aesthetics based on multiple prior studies. Not surprisingly, he concluded that inner city children preferred savanna settings over forests, wetlands, or prairies. Tight clumps of trees were less attractive than evenly spaced trees in park-like settings, and opening of forest canopies by thinning and selective harvests in rural or wild settings consistently increased preferences (Gobster, 1994).

Gobster was primarily focused on people's preference in urban settings. Like most savanna-like landscapes we see daily, ecological integrity, (especially in urban settings) is at the expense of aesthetic preference. Gobster found that inner-city children held lower preferences for native savanna, and were instead inclined toward a more formal savanna landscape, with elms and conventional lawn. Additionally, visitors to the NC Botanical Garden perceived ecological community displays as unkempt or overgrown when provided no prior knowledge of native plants or ecology. Interestingly, in wild land settings people did prefer savannas with high ecological integrity (Gobster, 66, 1994). This exposes an important factor in advocating for grassland landscapes, (or any landscape) as a successful design tool: culture and context matters.

In the context of the rural Georgia Piedmont, there is certainly a well-established ecological aesthetic, if not by choice, by the realization that “nature” will not be controlled, but can be appreciated and to an extent managed. As one of the owners at Two Swallows states of their ecological aesthetic:

> We can struggle with the various species that get in our way or we can make room for them, often to great benefit. This is one lesson of succession in my view: Nature will thwart the best-laid plans of the aspiring gardener or farmer, often to great and positive effect (Tufts, personal communication, 2016).

The choice to appreciate, rather than control, reflects an understanding of a more complex and intricate landscape that functions not only as pleasing view, but as habitat, food source, pollutant filter, moisture retention, and erosion control for land rural residents depend upon.

Design Qualities

For those in an urban environment, the ecological aesthetic described above may seem foreign, often avoidable, and the resulting landscape as unintentional or messy. There has been extensive research on the perception of naturalistic planting design within the urban realm by horticulturists and planting designers like James Hitchmough, Nigel Dunnett, Noel Kingsbury and Anna Jorgensen. The less researched rural setting offers new opportunities for design and ecological processes. This thesis maintains vegetation ecologists’ definition of “naturalistic” planting, as a style that forms spontaneously and is dominated by ecological processes (van der Marl 2005).

Motivations for Biotope/Natural

Naturalistic planting design is influenced by both design and ecological aims, and is closely suited to the rural ecological aesthetic described by the client at Two Swallows Farm.

Horticulturists James Hitchmough and Nigel Dunnett have written extensively on supplementing horticultural ornamental plants to make naturalistic communities more aesthetically pleasing than purely wild or ruderal landscapes (Hitchmough, Dunnett et al. 2004, Hitchmough 2011, Hitchmough 2011). Similar to naturalistic planting design and the necessity for low maintenance, "biotope planting" is defined as a plant community "with all the dynamism of a wild habitat and clearly resembling natural habitats in terms of structure, but whose species mix is chosen for an aesthetic effect, as well as their ecological suitability for the conditions at the site. Maintenance is generally extensive (i.e. with minimal input)" (Kingsbury 2004 p. 60). Hitchmough and Dunnett's research is often concerned with seed mixes comprised of North American prairie forb species and meadow grasses native to the United Kingdom (Hitchmough and Woudstra, 1999). This aesthetic was exhibited at *Queen Elizabeth Park* during the 2012 Olympic Games, and for much of the public was an introduction to the design approach.

Though much of the research on public perception of naturalistic, or "wild-looking" herbaceous vegetation has been done by British and Dutch planting designers, this aesthetic among planting designers in America began in the early 1980s with James van Sweden and Wolfgang Oehme (The New American Garden Exhibition, 2015). In a short video documenting the roots of the New American Garden aesthetic, James van Sweden states that "we were using perennials in a meadow - like way that was very different than what anybody else was doing." The garden style is named after The New American Garden at the National Arboretum, a name given by the Arboretum's then Director, Marc Cathey (The New American Garden Exhibition, 2015). In the early years the new concept was given many names: "laissez-faire gardening," "a garden for all seasons," and "the low maintenance garden" were just a few. At the time, "painting" the landscape with enormous swaths of color with individual species seemed dramatic and out of scale. Unlike Hitchmough and Dunnett, the New American Garden at times deviates from a specifically meadow look, though for the most part, the tradition promotes inherent ecological, aesthetic, and ornamental qualities of meadows.

Naturalistic planting beginnings

The impetus for these new planting paradigms varied between European and American planting designers. Hitchmough, in a 2008 paper on the relevance of ecologically based, designed urban plant communities in the United States, states that research or new planting paradigms in the U.K. resulted from two long – term problems affecting Britain's urban parks and green space (Hitchmough, 2008). He states that motivation for conceiving new paradigms resulted from "a significant decline in the funding of maintenance programs and the erosion of horticultural vegetation maintenance and management skills within urban park authorities" (Hitchmough, 2008). The United States is not without those very same issues, (more severe today than ever) but the initial inspiration for the New American Garden came from abstract expressionist art and wild American landscapes van Sweden experienced as a child.

Van Sweden attributes much of his inspiration from paintings by Hans Hofmann and Helen Frankenthaler. "The New American Garden style was definitely inspired by paintings" "I think you can see how a Helen Frankenthaler painting can be a metaphor for a garden of any scale, and I think that was important for the New American Garden" (The New American Garden Exhibition, 2015).

Adding to those artistic influences, van Sweden was inspired by the Dutch landscape architect Mien Ruys, along with experiences in Michigan as a child. The New American Garden might act as a metaphor for the American Meadow and is similar to Jens Jenson's approach to Prairie Style landscape architecture, which emphasizes horizontal lines, layering, and the relationship between sky and landscape. Van Sweden experienced this distinctly American "wild" as a child in rural Michigan, saying that "walking through meadows, and the landscape of Michigan along those railroad tracks had a great deal to do with it" (The New American Garden Exhibition, 2015). It isn't surprising then, that Mien Ruys' work with perennials, and the older

“New Perennial” movement in Europe was foundational in creating what became a distinctly American design language.

The origins of planting design in America that mimicked natural vegetation forms, liberated plantings from forced, artificial forms and spoke to the prairie was not entirely rooted in America. Despite this, the American concept of wilderness, and of the frontier proposes a meadow design that appears even less influenced by man than European counterparts. The 18th century theorist William Gilpin proposed that picturesque is in part about improving upon, and in many ways pacifying nature (Gilpin 1792). Describing the picturesque as a slightly more domesticated version of the sublime, painted scenes in 18th century England depicted an idealized version of nature, with nature and man coexisting in a landscape, or man’s effect on tidying nature in some small way (Gilpin 1792). Instead of taming nature, depicting human influence, or simplifying an otherwise completely wild scene, landscape painting depicted untouched wilderness and something entirely apart from human influence. (Townsend 1997, Carlson 2009).

The sheer size and unfamiliarity of the American landscape to European immigrants imparted a unique conception of wild, distance, and of an “undiscovered” frontier. This concept of a purer/less altered nature resonates with perennial meadow planting design in America today that is less tidy, more native, and has a greater responsibility to speak to the eco-regional culture.

Rural Piedmont Frames

Joan Nassauer’s critical *Cues to Care,* which demonstrated that the perception of seemingly unkempt, naturalistic vegetation could become more culturally acceptable through “frames” of human intent takes on new meaning in the rural Georgia Piedmont (1995). The land may appear “messier” than most urban settings, but the rural Piedmont is far from wild. Rural perceptions already favor more natural design configurations over cultural, so cues of human intention are given greater latitude. Simple boundaries of forest edge, fence line, swale, and structures provide organization in the landscape, leaving only discretion to emphasize areas of intentionally designed plantings. Instead of clean boundaries or highly maintained edges, habitat edges, pastures, and fence boundaries indicate much human intent and maintenance.

Nassauer has been critiqued as proposing a safe, comfortable place to view the unpredictable mess of truly wild, ecological plantings without actually interacting with it. This reflects a lack of cultural understanding or interest in nature, instead favoring a more picturesque, two-dimensional relationship. On a small Piedmont farm these “frames” of human intent don’t pacify nature and merely allow one to look on as a spectator viewing a wild landscape because the landscape isn’t wild, it is working. It is a working landscape that must function for agricultural needs.

The greater acceptance and appreciation for wild-looking, “natural” landscapes that Paul Gobster described, supported by the “appreciation, not control” perspective described by the owners of Two Swallows farm embodies the rural Piedmont Meadow aesthetic. The New American Garden may have some roots in the much older, European New Perennials movement, but more importantly to painterly and “wild” influences that speak to a distinctly American aesthetic. Early depictions of the American landscape conveyed a land untouched by man or tradition. Early American designers also attempted at the picturesque composition, but also saw the value in natural forming vegetation (Olmsted, 1973). A farm in the rural Georgia Piedmont is anything but wild, it is designed landscape. It is also far from a composed scenographic experience, but a working agricultural landscape. This creates an opportunity to express the significance of this place on the Piedmont though planting design, without neglecting natural models and plant communities. More than creating an opportunity to develop a design aesthetic where the domestic and untamed meet, the southern meadow aesthetic is attractive because it is productive. Formerly unproductive patches of land throughout a farm can fulfill aesthetic and productive needs.

Productive Plantings / Functioning Meadows

There is a need for meadow landscapes beyond human preference, historical presence, or artful design. Perhaps even more than most urban settings, it is important that rural planting designs function ecologically, and specifically as pollinator habitat. Other ecosystem services such as nutrient cycling, water management, carbon sequestration potential, and even recreational benefits are important and inherent to any designed meadow, but none are more critically needed in this landscape as pollinator habitat.

Lack of Rural Habitat

Somewhat surprisingly, urban settings with small, diverse food gardens, ornamental plantings, and diverse tree species provide pollinator habitat in needed numerous small patches much better than most rural agricultural settings (Potter and LeBuhn, 2015). Non-forested areas in the rural Georgia Piedmont are dominated by undulate forage and row crop production, resulting in a near-monoculture outside of roadside remnants, powerline easements, and flower or food gardens. Because insects pollinate all but a few food crops (the rest relying on birds and bats) habitat for insect pollinators is particularly critical (Klein et al., 303, 2007). Significant declines in pollinator populations which have accelerated sharply since 2004 are a result of damaging insecticides, parasitic mites, and habitat degradation due to monocultures, in turn creating subsequent declines in flowering plant populations (Nicholls, Clara, and Altieri 2013) (Klein et al. 2007).

The National Resource and Conservation Service estimates that three – fourths of the world’s flowering plants and 35 percent of the world’s food crops depend on animal pollinators to reproduce (NRCS, 2015). And even for food crops not reliant on pollinators, more than 3,500 species of native bees help to increase yields (NRCS, 2015). More specific research reveals how animal pollination diffusely affects humans’ survival.

In a 2007 article, pollination ecologist Alexandra-Maria Klein examined humans' reliance on animal pollination for world food crop production. Outside of complete pollinator dependence, her team found that production of 29 of the leading 57 single crops (non-commodity) increases with pollinating animals (Klein et al. 2007). Using primary data from 200 countries, they found that fruit, vegetable, or seed production from 87 of the leading global food crops is dependent upon animal pollination, while 28 are not (Klein et al., 303, 2007).

Animal-mediated pollination contributes to the sexual reproduction of over 90% of the approximately 250,000 species of modern angiosperms (Kearns et al. 1998, Aizen et al. 2009). Aside from direct annual animal pollination of food crops, maintaining biodiversity of all flowering plants is important in crop specialization, disease resistance and directly contributes to the integrity of most terrestrial ecosystems on Earth. (Aizen et al. 2009).

The significant dependence on animal pollinators for food crops is clear, however the majority of caloric intake for humans comes from cereal crops that require no animal pollination. Due to wind pollination, solely passive self-pollination, hybridization or parthenocarpic varieties, production levels of most commodity crops will not fall significantly with pollinator habitat loss.

But beyond caloric intake, our diet "would be greatly impoverished, both nutritionally and culturally, if pollination services further decline" (Klein et al., 303, 2007). An example of this are the many fruit crops that rely on animal pollination to greatly increase fruit production. Many fruit crops provide essential macro- and micronutrients contributing to a healthy diet (Klein et al. 2007). These lesser known nutritional services from pollinators refute claims that rural pollinator habitat may be sufficient simply because many commodity crops are not dependent. Still, indirect effects from pollinators benefit commodity crops that don't require animal pollination, which will be discussed in the following section.

Pollinator Significance

Attempting to quantify food crop dependence on pollinators is difficult, as crop reliance on pollinators is along a gradient range, and seldom exclusively one or the other. Additionally, even within a single food crop, (such as highland coffee) increased production levels due to pollinators varies widely depending on the variety. A general lack of research on pollinator dependence presents a similar story with many food crops (Klein et al., 303, 2007).

Estimates that 35 percent of world food crops are dependent on animal pollination is important, though fails to communicate our relative reliance as it relates to complete human nutrition and ecosystem biodiversity. Similar to the example of fruit crops above, the nutritional contribution of many animal-pollinated crops in terms of proteins, vitamins and mineral "may be much more important for the human diet than the total mass of production would suggest" (Steffan-Dewenter et al. 2005). Production of staple crops (corn, wheat, cassava, potato, rice) has doubled in the past 50 years due to improved strains, agrochemicals, irrigation and other agricultural methods (Eilers 2011). These grains and starchy vegetables provide the majority of calories in the human diet and do not depend on animal pollination, but are also poor sources of micronutrients. For instance, animal-pollinated crops "contain the majority of the available dietary lipid, vitamin A, C and E, and a large portion of the minerals calcium, fluoride, and iron worldwide" (Eilers, 2011). So as yields of pollinator dependent crops increase, so does the potentially devastating effect on human nutrition if jeopardized. Micronutrient deficiency, or "hidden hunger" affects over two billion people worldwide, and dependence on few, self-pollinated staple crops only underscores the importance of diet diversity and the need for animal-pollinated crops and the habitat that supports them (Eilers 2011).

Finally, but perhaps the most immediately influential in affecting agricultural policy, are diminished economic returns as a result of lost pollinator habitat. It is extremely difficult to assign monetary values to ecosystem services, as they aren't directly traded in the market place. Valuations for these services also vary widely, with different methods of measurement, value systems across cultures, scales of analysis, and ever-changing value of money (Eilers 2011). In a 2012 analysis, Sven Lautenbach of the Helmholtz Centre for Environmental Research in Leipzig, Germany, along with colleagues cited an estimate of $153 billion for the international economic value of pollination. Assessing the monetary cost of habitat loss is equally difficult.

A German study from 2011 stated the "global economic value of pollination from domesticated and wild animals was estimated at € 153 billion, while the consumer surplus loss associated with the total loss of animal pollination service was estimated between €190 and €310 billion (Eilers 2011). Eilers' article provides broad estimates, but articulates an alarming reality. Consumer surplus is continually reduced not only due to loss of pollinator habitat (quantity supplied), but also the ongoing increase in pollinator-dependent crops (quantity demanded). The estimate resonates further if one replaces "consumer surplus" with "dietary needs." More than merely nearing (or exceeding) consumer's "willingness to pay," or "satisfaction," ultimately the conversation is concerned with world nutrition needs. Global demand for pollinators is increasing due to increasing popularity of certain crops, while simultaneously, supply to meet this demand is decreasing with continual habitat loss.

> Cultivation of pollinator-dependent crops has, on average, been expanding faster than that of non-dependent crops in both developed and developing countries over the period 1961–2006, so the demand for pollination service is rising at the same time that pollinator abundance and diversity are declining. In the near future, such opposing trends threaten crop yields […] (Aizen et al. 2009).

Popularity aside, overall globalization and increasing wealth in population-dense developing countries has led more sophisticated and complex diets. Adding to that, as developing-world diets are comprised of increasing amounts of animal protein, additional pollinator habitat is lost to intensive grazing (Godfray et al. 2010).

In the United States, Nicholas Calderon of Cornell University estimated the value of honey bee pollination alone to US agriculture at roughly $17 billion in 2009 (Watanabe 2014). Calderon added that while pollinator-dependent crops have increased, honey bee hive numbers have not kept up to nation-wide demand (Watanabe, 2014). Though these crops are relatively small-volume compared to human's caloric staples, they often supply needed micro-nutrients and provide disproportionately large economic returns that are important for local markets.

The simultaneous habitat loss / demand increase presents an interesting and unfortunate cycle. As pollinator populations continue to decline in the face of increasing demand, an unavoidable "production reduction" occurs. Aizen and colleagues estimated that worldwide, "the expected direct reduction in total agricultural production in the absence of animal pollination ranged from 3 to 8 %, with smaller impacts on agricultural production diversity (2009). The reduction may seem relatively minor; however, it is cyclical. Decrease in production will increase demand for agricultural land, only further reducing pollinator habitat. Ultimately this may cause a reversion to fewer pollinator-dependent crops, and will almost certainly contribute to global climate change through the myriad of negative effects associated with intensive production agriculture.

Need for Grassland Habitat

To counter the food crop "production reduction" cycle it is important to establish the specific need for grassland pollinator habitat. Increasing rural habitat for invertebrate pollinators is critical. It is in these habitat patches - in powerline easements, food gardens, and remnant habitat connectors - that the potential for productive grasslands exists. Reduced land maintenance costs, increased biodiversity, and the beneficial appearance of naturalistic plantings makes previously underutilized land a "new" rural asset.

As mentioned above, populations of wild pollinators in rural settings are frequently too sparse to adequately pollinate crops in agriculturally intensive environments (Klein et al. 2007). Urban environments benefit from comparatively dense, if smaller habitat patches, and a diverse range of native and non-native ornamental plantings. Land use on the rural upper Piedmont in Georgia is dominated by food crops, pastures for grazing undulates, and abundant timber resources, but offers numerous opportunities for grassland pollinator habitat.

Food crops on the upper Piedmont consist mainly of cotton, grass forage, soybeans, and wheat. Beef and dairy cattle are also common, but pale in comparison to poultry farming. Chicken broilers (raised for meat production) are Georgia's largest single agriculture commodity, and as of 2007 accounted for more than 45 percent of the state's agriculture and agribusiness economy (UGA Extension, 2012). As of 2007, there were 5,500 poultry farms in the state, and since its inception in Hall County the 1930s, the industry has been concentrated in North Georgia. This research will not examine the environmental impacts of modern poultry production, though it is important to the discussion as the physical footprint of modern, enclosed poultry houses provides abundant interstitial space for pollinator habitat.

Biodiversity

An abundant and diverse array of flowering plants is the most important element in any high-quality pollinator habitat, and aside from some rangelands Piedmont agriculture practices minimize or entirely ignore this significance (Gilgert 2011). With honeybee populations in sharp decline in the last decade due to Colony Collapse Disorder (CCD), food production costs have increased while crop yields have fallen. Reliance on one, introduced pollinator species in the face of population collapse perpetuates an expensive, inefficient cycle.

Native bees have been pollinating North America's flowering plants long before the introduction of honey bees, and continue to do the majority of pollination, even in today's significantly altered landscapes (Moissett, Buchmann, and Buchanan 2011). Honey bees are also unable to pollinate tomato or eggplant flowers, and are a poor pollinator of native plants like pumpkins, cherries, blueberries, and cranberries. Despite being effective and adaptive pollinators, in the face of increased costs and availability of rented honeybees, the best pollination alternative are already present and more effective native bees.

There are 3500 native bee species in North America, 500 of which are native to Georgia (Adamson 2015). The vast majority of these native species are solitary, meaning once a single female mates, she will make and provision a nest alone. This is different than honeybees, which share a community with sisters and a queen. Because solitary bees do not share labor, and must collect pollen and nectar on every foraging trip, (protein in pollen and carbohydrates in nectar) for she and her young (Adamson 2015). By collecting pollen and nectar in every trip they are much more effective pollinators as they make contact with both male and female flower parts (Adamson 2015). Honeybee foragers typically collects just one or the other.

Another reason native bees are especially effective pollinators is that some plants in the Ericaceae family, (which includes blueberries, huckleberries, and sourwood) and Solonaceae, (which includes tomatoes, eggplants, and peppers) require sonicated pollination (Adamson 2015). Sonicated, or "buzz pollination" requires a certain frequency of vibration (via wing muscles) that causes flower's poricidal anthers to release pollen. Most native bees "buzz pollinate," while honey bees do not (Adamson 2015).

Because of this specialization native pollinators are more effective than honeybees at pollinating, but also sustaining and increasing the biodiversity near food crops. Grasslands and open ground habitat that supports their nesting must be expanded. By filling habitat niches through nesting, pollen-strategies, size diversity, and behaviors, (early spring emergence or prolonged daily foraging) native bees provide an effective pollinator for every fruit, nut, and vegetable crop, and without cost. (Moissett, Buchmann, and Buchanan 2011).

Despite specialization to specific niches, due to insufficient habitat populations of wild pollinators are often too sparse to adequately pollinate crops in agriculture environments, Alexandra Klein and colleagues’ 2006 paper on the importance of pollinators outlines four specific actions be incorporated into land management plans: (i) Increase nesting opportunities with the particular nesting needs of different pollinating species in mind, which may include gaps in surface vegetation, leaving dead wood that provides holes for cavity-nesting bees, or retaining neighboring forest nesting sites for ground-nesting bees (Cane 1997, Klein et al. 2007). (ii) Increase forage by providing diverse floral resources during the season of pollinator activity, and crop rotation using flowering plants should be applied in intensive agriculture landscapes to enhance other ecosystem services such as soil improvement, pest management, and erosion control (Kevan et al. 1990, Klein et al. 2007). (iii) Increase opportunities for pollinator colonization by connecting habitats with flowering strips and hedgerows around arable fields, small forest patches, or even single trees as “stepping stones” (Klein et al. 2007). (iv) Reduce the risk of population crashes in field and surrounding habitat by foregoing use of broad-spectrum insecticides during bloom (Klein et al. 2007).

With the benefit of adjacent woodlands already present at Two Swallows Farm, all of the above recommendations speak directly to the need for increased meadow pollinator habitat. Klein and colleagues’ article provides best management practices, though does not attempt to answer just how much of this habitat is sufficient for wild pollinators.

Amount of Pollinator Habitat

Even long term studies have been unable to provide a clear answer. A recent study from the University of Cambridge found that just 2% cover of flower-rich habitat on a 100ha parcel was sufficient to support wild bee species, though the researchers note only six species were studied, and too many variables and assumptions generated too much uncertainty to establish any kind of prescription (Dicks 2015). Though general, the figure does allude to the relatively small commitment it would take on the part of individual landowners to support beneficial pollinator habitat throughout conventional agriculture landscapes. Financial burdens from implementing pollinator habitat could be ameliorated through ag-environmental schemes already present in the United States, which compensate farmers who implement management strategies to enhance biodiversity.

Native vs. Non-native Plant Species

The importance of meadow-like pollinator habitat is clear, however the debate between using native or non-native plant species is ongoing, and in many ways a matter of prioritizing aesthetics or pollinator efficiency. University of Sheffield planting designers James Hitchmough and Nigel Dunnett, discussed earlier as early pioneers in naturalistic plant communities, have no hesitation in using both native and non-native species to create semi-natural grass and forb meadow landscapes. For them, the focus is on creating ecologically functional and lower-maintenance landscapes, but also visually dramatic landscapes that arrest attention.

The two primary reasons Hitchmough and his colleagues use a mixture of native and non-native species are to fulfill the needs of unusual or extreme site conditions, such as an ecologically hostile green roof, and the simple fact that the British Isles have relatively little native flora (Hitchmough 2008). The British Isles have only 1140 truly native species, and a green roof in the center of a city could present living conditions outside of the niche ranges of desirable native species (Hitchmough 2008).

Hitchmough's position is more concerned with the physiological and ecological niche ranges of individual species, and how it expresses itself in a given plant community. A plant may be exotic, but it is still able to form ecological relationships and attract pollinators. Further, sowing seeds *in situ* distributes seeds randomly and retains the look of wild habitat. This is markedly different than Oudolf and Oehme and Van Sweden, where species are planted in large groups (Hitchmough 2008). The desirability to pollinators between to the two approaches is unclear, though one can assume any likening to wild habitat increases pollinator access and visits.

To Dunnett and Hitchmough, a final but important reason for using non-native species is their importance to urban cultural tradition (Hitchmough 2008). Imparting cultural value, and meeting laypeople "where they are" meets some requirements of Nassauer's "Cues to Care" hypothesis. As found in earlier examples of acceptance of naturalistic planting design, in an urban setting, planting designs must immediately communicate value, and cannot contain some kind of coded goodness. In Georgia's rural Piedmont, this is likely less important at a great distance from human activities, but an important consideration near building envelopes and greater human interaction.

If the goal is designing the most effective pollinator habitat, there may be some benefit to planting only native species, although the realized benefit is marginal and dependent on pollinator species and flower type, among other variables (Salisbury et al. 2015). In testing the overall value of native vs. non-native plants to invertebrate pollinators, Salisbury, et al. found that overall floral abundance resulted in more pollinator visits than plant origin (native vs. non-native) (Salisbury et al. 2015). Although there were trials where overall abundance of pollinators was greatest on native or nearly-native treatments, discrepancies occurred when trials were limited to specific species, (such as long-tongued bumble bees, or solitary bees) (Salisbury et al. 2015). In general, the researchers found that overall flower visits corresponded more with peak flowering time than plant origin (Salisbury et al. 2015). Salisbury and colleagues' article demonstrates that using both native and non-native plants may provide optimal pollinator habitat, but more importantly a variety of flowering plants with different bloom times will provide habitat for more specialized pollinators. Similarly, there is little detriment to establishing a purely native landscape, as long as peak bloom times correspond with the native pollinator species present.

The value of pollinator habitat is ever increasing, not only to pollinator dependent food crops, but also to the commodity, self-pollinating crops, as demand for new agricultural land increases. This has far reaching effects beyond relatively minor reductions in crop yields. Marcelo Aizen and colleagues proposed that "pollination shortage will intensify demand for agricultural land, a trend that will be more pronounced in the developing world. This increasing pressure on supply of agricultural land could significantly contribute to global environmental change" (Aizen et al. 2009). Coupled with the very clear need for pollinator habitat, the relative ease and low cost of implementing better management practices listed above should spur rural landowners to introduce habitat in near food gardens, in power easements, and in the multitude of remnant habitat spaces between working agricultural areas.

The ecosystem services and pollinator habitat potential at the 135 acre Two Swallows Farm site is enormous, among flowering grassland species and forest edges. Studying examples of established designed meadows in the same region as the Two Swallows site is the next step in implementing a productive meadow landscape.

Chapter 4

Case Studies

Three designed meadows were selected as models for the Two Swallows site. The Sandy Creek Nature Center Piedmont Prairie Restoration in Athens, Georgia, John Kelly Meadow at the South Carolina Botanical Garden, and Hahn Meadow Garden at Virginia Tech were selected primarily because of their similar climate and soil characteristics. Their relatively small size (<3 acres), low grass-to-forb ratio, and emphasis on using native plants and record of management regimes were also important factors.

Sandy Creek Nature Center Piedmont Prairie Restoration

Location: Clarke County, Georgia. 205 Old Commerce Road, Athens, GA.

Size: .25 acres, expanding to .33 acres in 2016

Established*:* December 2005

Clearing Method: Low mowing; physical removal of pine saplings; 2-4D, tilling

Establishment Method*:* Broadcast seed and some 1-3 gal. potted grasses

Grasses: Forbs Ratio*: 60 : 40*

Mowing or Burning Regime: First Burned in March 2006, and repeated nearly every year since. Typically burned mid-March. Mown only when new, growth in spring appears and season starts earlier than expected.

The Piedmont Prairie Restoration was established in 2005 primarily with native warm season grasses. Forbs were planted beginning in 2006 and now make up ~40% of the meadow. Constant deer foraging requires frequent forb replacement.

Invasive species are controlled by physical removal, or with 2,4D or RoundUp herbicide (2-4D for crabgrass and foxtail; Roundup for fescue). Physical removal of invasives occurs in early

December, and new forbs are planted in April or early May. Seeded grass species are sown in late November or early December. See species list in the Appendix.

Most common invasives being controlled:

- -Frostweed, (*Helianthemum canadense*)
- -Blackberry *(Rubus fruticosus*)
- -Dogfennel (*Eupatorium capillifolium*)

Other common invasives being controlled:

-*Lespedeza sericea* / *L. cuneata* constantly creeping in. (This legume is good, vigorous forage and can thrive in poor soil and drought.

-Foxtail (*Setaria*) is the most pernicious grass

-Crabgrass (*Digitaria*)

-Fescue (*Festuca*)

Fig 4.1. Sandy Creek's annual prescribed burn on Friday February 19, 2016.

Hahn Meadow Garden

Location: Hahn Horticultural Center. Virginia Tech campus, Blacksburg VA.

Size: .66 acre

Established*:* 2008

Clearing Method: Herbicide

Establishment Method*:* Plugs or quart-sized flowering forbs and large grasses.

Grasses : Forbs Ratio*: 70 : 30*

Mowing or Burning Regime: Mow annually

Though set apart from most meadow species, the site features many native trees and shrubs as well. Unlike Sandy Creek or the John Kelly meadow, most grasses and forbs are planted in the sweeping "New American Garden" style. This effect creates stands of just 2-3 species that are interwoven with other pairings throughout the site. The massing highlights plant associations, emphasizes plant texture layers, and allows greater visibility for showy species. The on-site outdoor amphitheater brings users closer to meadow plantings, necessitating the more specific planting plan showcasing horticultural interest. See species list in the Appendix.

Fig 4.2. Layered planting groups at the Hahn Meadow Garden.
Turf-type *Bouteloua dactyloides* in foreground.

Fig 4.3. Sweeps of perennials with amphitheater in background.

John W. Kelly Meadow at South Carolina Botanical Garden

Location: South Carolina Botanical Garden. 150 Discovery Lane, Clemson, SC.

Size: 2.5 acres

Established*:* 2000

Clearing Method: Repeated applications of Roundup herbicide

Establishment Method*:* Plugs for all species

Grasses : Forbs Ratio*: 60 : 40*

Mowing or Burning Regime: Meadow is burned each late winter in February

Fig.4.4 The large Kelly meadow is located alongside the main entrance to the Botanical Gardens.

The Kelly Meadow site maintains deep, rich topsoil as a result of never being plowed. Rich topsoil increases competition from weeds, making plugs a necessity in order for intended meadow plantings to thrive. Repeated applications of herbicide were necessary to kill unwanted grass seedlings, and a prescribed burn each year in late February discourages cool season grass establishment. Plugs were local genotypes, and unlike Sandy Creek's Piedmont Prairie, from the onset a mixture of grasses and forbs were used. The Lark Wildflower Meadow and former Butterfly Garden are also located within the Kelly Meadow. See species list in the Appendix.

Even in the most local example of the prairie restoration at Sandy Creek Nature Center it is clear that meadow establishment is difficult without some application of chemical herbicide. In most precedents, repeated applications of chemical herbicide were necessary to control unwanted weeds, especially persistent cool season grasses. This is part of the unique challenge of planning and maintaining a designed meadow in plant hardiness zone "8a," with significantly greater rainfall and much milder average minimum temperatures. It is possible to establish meadows with repeated annual burns and physical removal of unwanted grass weeds, though this approach can take years to arrive at a desired species composition as burning stimulates germination of dormant seeds.

The three precedents also exhibit different planting styles. Hahn Meadow Garden's sweeping, more specific planting plan is comprised of native grasses and forbs, but reminiscent of Oehme van Sweden's New American Garden. The rural setting of Two Swallows Farm requires less specificity in exhibiting Nassauer's "frames" of human intent, and a planting and management plan more reflective of Sandy Creek Nature Center is appropriate (Nassauer, 1995). Initial establishment of important warm season grasses and forbs, and continual removal of unwanted species, annual burns, and additions of new desirable species speaks to Two Swallow's approach to landscape management, not landscape control. Additionally, Two Swallows' rural setting favors the more natural design configuration reminiscent of historic Piedmont prairies and existing early successional species in power cut right-of-ways.

Based on the composition and management of the above precedents, the following section will provide species lists, establishment and maintenance regimes most successful for maintaining a successful meadow in the Georgia Piedmont. Although influenced by the precedents, all of the species listed are native to the eastern United States, and appropriate for this planting zone, soil, and water requirements.

Chapter 5

Design

Site Context

Two Swallows Farm is located on Transco Road approximately 5 miles northwest of Comer, in Madison County, Georgia (Fig. 5.1). The 135 acre farm straddles the Cedar Grove Branch of Scull Shoal Creek, which flows into the Broad River four miles to the northeast.

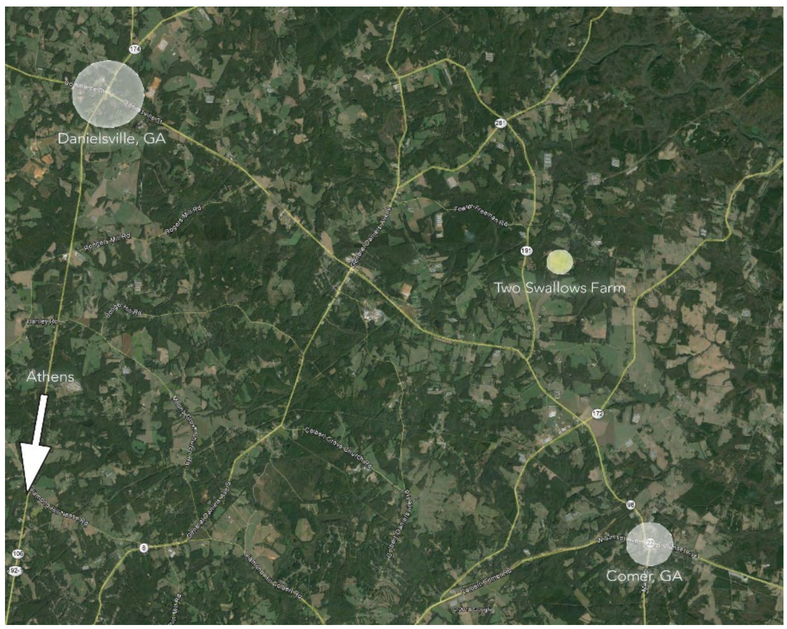

Fig.5.1. Two Swallows Farm between Comer and Danielsville, Georgia, roughly twenty miles northeast of Athens.

Transco Road is named for the Transcontinental Pipeline, which carries natural gas from the Gulf Coast states, to Pennsylvania, New Jersey and New York City. In the aerial image of the Two Swallows property (p. 71), the Transco Pipeline easement can be seen in the roughly 80' swath of cleared woodland running nearly 350 yards through the northwest portion of the property. This treeless swath has little direct connection to the designed meadows at the focus of this thesis, but much to do with the aesthetic and habitat corridor qualities, along with the plant species maintained by cleared woodlands. The client's prioritize a native grassland planting design near the new farm manager's house, and the desire is to be in some degree reflective of the de facto grasslands maintained by the Transco and powerline easements already on the property. The cleared woodland corridors host important native genera such as *Andropogon, Sorghastrum, and Solidago.*

Roughly two-thirds of the property is mixed hardwood forest, most of which existed prior to 1944. In the following historical images it is important to note both the terraced agricultural fields and lack of tree cover in 1944. In the decades following, encroaching early succession forests begin to repopulate fence rows forest edges, and lower lying areas.

Today, the field terracing is gone aside from a few relics remaining in the wooded areas nearest the pond. When the pond was created through construction of a dam, the fields were terraced in a way to prevent field runoff from contributing to the spring-fed pond.

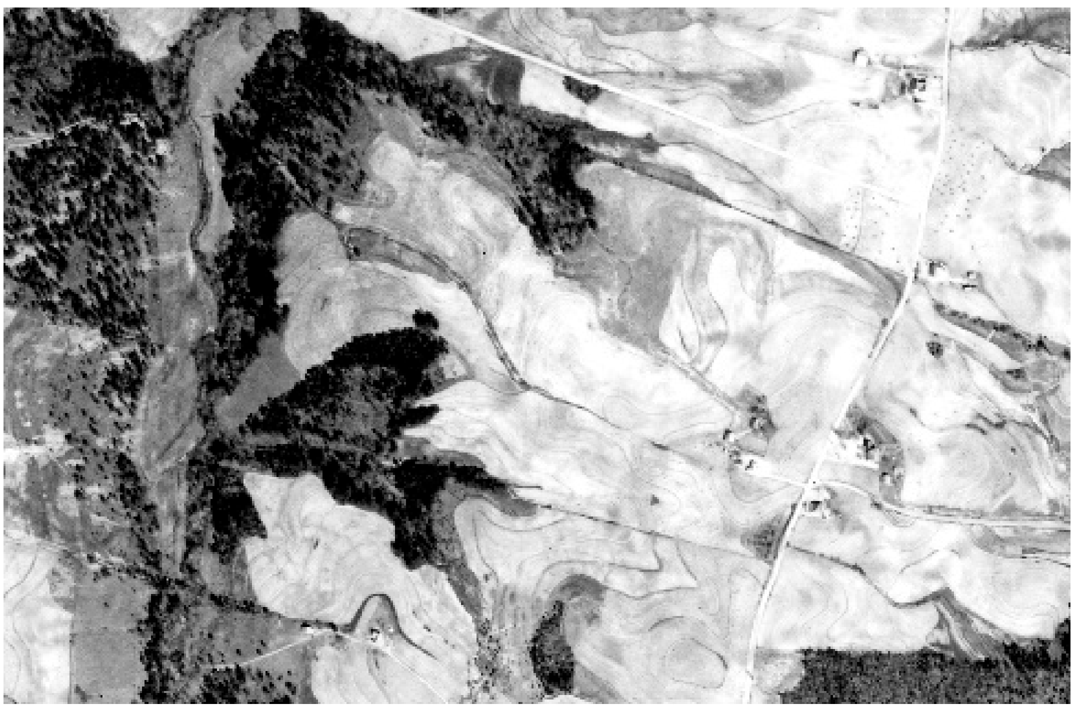

Fig.5.2. 1944 aerial image of Two Swallows Farm. The main home and barn site is right of center, west of Transco Road.

Fig. 5.3. 1973 aerial image of Two Swallows Farm. The main home and barn site is right of center, west of Transco Road. Note the increase in tree cover since 1944

Viewing the most recent 2016 image below, the low lying, swale areas are void of tree cover but unutilized for any type of agricultural production. There is a clear opportunity to make these areas productive through pollinator habitat, water and nutrient retention, and most visibly enhancing the human experience as one moves throughout the farm space.

Fig.5.4. 2016 aerial image of Two Swallows Farm. The main home and barn site is right of center, west of Transco Road. Note the increase in overall tree cover, but diminished tree cover in lowland swale areas.

Process and Farm Manager's house.

As described in the first chapter, this thesis proposes to investigate the steps necessary to create and manage designed Piedmont meadows within an agricultural landscape in the Southeast. Planning for and siting a new farm manager's house, and the subsequent loss of a portion of horse pasture was the impetus for a native planting design that spoke to the needs of the land and interest of the client.

The incorporation of meadows extends through a large portion of the pasture and fallow fields of the farm, although this is not a farm master plan. However, siting the new house necessitated more specific planning of the house site, new access road, and fences in that area.

Finally, the Two Swallows farm site has a history of intense agricultural use. This is known through conversations with longtime area residents, and through historical aerial photography depicting extensive land terracing to maximize cultivated areas. Among the client's wishes for locating and planning the farm manager's house was a structure and surrounding landscape that incorporated itself into the history of the farm. The projective design has done this in multiple ways that will be addressed in the design and reflection discussion to follow.

Site Analysis

The four meadow typologies were developed after much time spent at Two Swallows during the previous three years. Working and experiencing the site in the full range of weather and seasonal conditions was invaluable in knowing the site and range of grassland characteristics throughout the farm. Distilling the variety of grassland habitats to four typologies allows for site appropriate species composition, and also a simple template that can be extended to all areas of the farm.

The Site Analysis on Map 3, (p. 73) describes the focus area for implementing meadows, which are generally kept within already cleared 40 acres of pasture and fallow field. Higher ground extending west from the main house continues downhill into a mid-field swale, covered in trees as late as the mid-1970s. Most of the water in the focus area drains to the central "pond trail" area immediately northwest of the barn. This pond trail and surrounding swale divides different livestock uses, with cattle and intensely managed pasture to the south, and less managed, horse pastures to the north.

Beyond the property line in the northeast corner of the farm, a power easement corridor cuts through wooded areas and connects to Transco Road where it intersects with what is locally known as "Junior's Road." An abandoned former state highway route, "Junior's Road" is used only by the adjacent property owners, and in conjunction with the power easement corridor, has potential to provide secondary vehicle access to Two Swallows.

The circle of high ground in the north horse pasture was selected as the future farm manager home site for many reasons. With forests to the north and west providing protection from winter winds, desirable views to the south, relative seclusion from Transco Road, and lack of pasture area to the new road alignment and surrounding meadows make this the most desirable house site on the property. Additionally, it fulfills the client's desire for the new house site to be in proximity to existing structures, while also allowing the main house to maintain a sense of privacy.

Site Soils

Over eighty-five percent of the land at Two Swallows farm is classified as "Madison sandy loam" soil by the USDA's Websoil Survey (2016). Fortunately, all of the planned meadow sites fall within this designation, and there is no indication of shallow bedrock affecting plant growth or construction of the new farm manager's house.

Soil nutrient tests were taken at each of the planned meadows sites to ensure pH was not too high or too low, and as part of general analysis prior to working on a large, agricultural site. Sample letters in Table 5.1 below correspond to meadow sites: A - Pond Trail, south side; B - Pond Trail, north side; C – Upland Sun, future house site; D – Forest Edge, part shade; E – Roadside, "Swale Sun".

				mg/kg (ppm)						%
Sample	LBC (ppm CaCO3/pH)	pH	Equiv. water pH	Ca	K	Mg	Mn	P	Zn	N
A	439	5.56	6.16	1206	195.6	179.1	10.03	51.92	11.30	.28
B	413	5.63	6.23	1426	137.2	229.4	8.88	40.33	7.97	.39
C	369	5.76	6.36	1269	202.9	163.7	7.65	28.03	6.42	.26
D	305	4.97	5.57	429	92.7	79.0	10.22	40.05	4.56	.16
E	660	5.37	5.97	1776	295.5	349.5	10.37	23.84	15.32	.56

Table 5.1: Soil Test Table

The tests revealed no surprises and healthier nutrient ratios than expected soil for an agricultural site in this region. Generally, all of the samples reflect a slightly acidic pH, which is favorable for meadow landscapes. Test values of pH greater than 7 would favor weed species.

Phosphorus values were slightly high, although its plant availability is limited by lower pH values. The greatest phosphorus levels appeared near the Pond Trail, and are likely due to horse and cattle manure in adjacent pastures. Lower pH values are advantageous for warm season meadows, as too much phosphorus encourages more weed species. However, even lower pH values are necessary to mitigate the effects of too much Phosphorus. Planting, harvesting, and removing a cereal crop such as corn or alfalfa silage from this area will remove some of the excess phosphorus, and paired with active physical weed removal over multiple years should create conditions no longer favoring early succession weeds.

The forest edge (D) reflects a slightly lower pH, likely due to organic acids present in the soil due to conifer trees. Still, the figure is not low enough to discourage meadow establishment, and small amounts of lime can be added to the soil to raise the pH if necessary.

Fig. 5.5. Two Swallows farm with a general topographic map projected. The small contour circle northwest of the main house reflects the high ground selected for the farm manager house site.

Four Meadows

The four meadow types for Two Swallows are “Upland Sun,” (native herbaceous species favoring dry soils and full sun), “Swale-Sun,” (native herbaceous species favoring wetter soils and full sun), “Partial Shade,” (native herbaceous species that are shade tolerant, favoring dry medium soil and shade tolerant), and the “House Envelope,” (showier native herbaceous species favoring dry - medium soils and full sun). The most appropriate locations for initial establishment are depicted below. These sites were selected for their multiple environmental characteristics, but also for aesthetic reasons. Enhancing and framing views, acting as gateways, enhancing existing use-type divisions and providing a consistent, showy planting plan are as important as the myriad environmental benefits.

Fig. 5.6 Existing conditions at Two Swallows Farm with future meadow locations.

Each typology has a unique species composition, aesthetic goals, and in some cases management regimes. As the primary assessment metric within the scope of this thesis is intended to focus on the aesthetic, to meet the expectations and sensibilities of the client, the majority of research is focused on management regimes that will lead to the desired aesthetic outcome.

Though a few species are present in multiple lists, each of the meadow lists is distinct. Environmental characteristics and aesthetics dictated the species for each meadow typology, but dominant genera of *Andropogon, Panicum, and Schizachyrium* appear on multiple lists. Those “classic” grassland species such as *Andropogon gerardii, Andropogon virginicus, Schizachyrium scoparium,* and *Sorghastrum nutans* provide the aesthetic meadow framework to build upon.

Similarly, *Carex* species typify the dominant species present in wetter and more shaded “Swale Sun” and “Partial Shade” typologies. Because most grass species thrive in full sun, the fewest grasses are seen in the “Partial Shade” mix. Generally shorter, shade-tolerant grasses still provide the understory framework signifying a meadow, but this typology is distinct in the presence of ferns, phlox, sedge, and species comparatively shorter than those found in the drier, sun-loving mixes. The “Partial Shade” mix is also identifiable in the frequency of white, cream, and pale blue forbs, and brighter green, cool season grasses.

The *Carex* species present in the “Swale Sun” mix are identifiable by brighter yellows and greens than the surrounding landscape, especially early in the summer. Along with the grass species, the dominant *Aster, Lobelia,* and *Eupatorium* will provide mostly cool colors with very few reds and yellows earlier in the summer than the “Upland Sun” and “House Envelope” types.

The “Upland Sun” mix is dominated by classic grassland species mentioned above, and warm colors from *Asclepias, Coreopsis, Rudbeckia, and Solidago.* Similar to the “House Envelope” typology, “Upland Sun” exhibits more bloom times extending into fall than the other typologies. The mix with the widest array of color and “showy” species is the “House Envelope” mix, with bloom times and color interest throughout the year, along with a mix of non-aggressive cool season, and more classic warm season grass. The Season of Interest Color Chart in the Appendix demonstrates color characteristics of each “House Envelope” species by month, along with height of each species.

The seed mixes are unique, and were compiled through conversations with professionals, nursery catalogues, and prior literature on meadow establishment. Lists were not transcribed from sources, but each species was selected for its native quality and habit among other meadow species in the Southeast. Aside from few specialist native nurseries, all sources for meadow seed contained some of non-native plants, or plants not native to the eastern United States. Reference material for compiling each typology included lists from Prairie Nursery, North Creek Nursery, Prairie Moon Nursery, and Philip Juras' important 1997 thesis on Piedmont savannas. Additionally, conversations and recommendations from W. Matt Whitaker, a landscape architect practicing in southern Tennessee with many successful meadow projects, aided in compiling unique mixes for this thesis. The lists for each meadow type are much longer and comprehensive that one would ever include in a single meadow. These lists are meant as a tool for selection and not a planting schedule.

In creating a successful seed mix, a total of 12-13 lbs of pure live seed per-acre is recommended for these site and climate conditions. This should be composed of 6-10 lbs of grasses, and 4-6 lbs of forbs. The species lists on pages 78-85 should be used as a guide to select from and not a seed mix of themselves.

Although the precedents were selected for their similar site characteristics, some included cool season grasses that would be particularly aggressive at the Two Swallows site in zone 8a-8b. Additionally, Two Swallows sites are comprised of species native to the United States if not the Southeast. An additional reference for these lists, Philip Juras' 1997 thesis on Piedmont savanna management, lists non-native species. Though many species are naturalized, it is the client's wish and a goal of this thesis to include only native plantings. Finally, rare species found at historic Eocene Chalk Prairies and other sites throughout Georgia have been included and highlighted.

(Meadow species lists in Appendix, pages 80-87)

Tree Incorporation

The presence of trees is a more minor but important component in the establishment of meadows as habitat and a food source for wildlife. Described in Chapter 2, "savanna" is often a better descriptor of historic Southeastern grasslands, interrupted by trees and shrubs with 10-15% tree canopy. In the meadows at Two Swallows, tree groupings provide important patches of habitat, while their varying seasonal color and structure enhance views and become small landmarks in the landscape.

Four factors directed the tree species selection process: seasonal aesthetic interest, (color, fruit, flower); quality as a food and habitat source for wildlife; and existing prevalence of the species in that landscape (tree selections should increase biodiversity). Finally, as with the surrounding meadows, all of the tree species are native to this region of the United States.

Trees are grouped to exhibit differences in structure and seasonal interest. For instance, *Nyssa sylvatica, Cladrastis kentukea, and Chionanthus virginicus* seen in along the Pond Trail in Drawing 1 (p. 74) exhibit a range of seasonal interest, size, and structure. The *Diospyros virginiana, Crataegus aestivalis,* and *Cladrastis kentukea* grouped in the Field Swale in Drawing 4 (p. 77) also reflect varied structures, are important wildlife food sources, and are appropriate for greater moisture habitats.

Trees surrounding the Farm Manager House Site were selected for similar reasons, with additional considerations of framing views from the house, sheltering the house from prevailing winter winds, and defining the entrance experience. Trees in this area had to also frame the house in the landscape. Incorporation of *Cornus florida, Cercis Canadensis*, and *Carya tomentosa* as a specimen tree reflect the greater weight emphasis on aesthetics near this new house site.

A Phased Implementation Plan

In the maps and drawings of each meadow site, (pp. 74-78) it is important to reiterate the importance of phasing when incorporating these meadows into Two Swallows' landscape. Earliest phases can be accomplished in smaller areas with low cost and high visibility, while later phases near the planned house site and surrounding upland meadow can be added once the structure is built. Future expansion of early sites along Transco Road and into wooded areas towards the pond will also come in later phases.

The Pond Trail site, seen in Drawing 1, (page 74) will use the “Swale-Sun” meadow mix and maintain a path from the main house site, towards the pond to the northwest. Along with meadow plantings, appropriate tree species of *Nyssa sylvatica (*Black Tupelo), *Cladrastis kentukea (*Yellow wood), *Cercis Canadensis (*Redbud), *Liriodendron tulipifera* (Tulip Poplar) and *Chionanthus virginicus* (Fringetree) offer habitat to birds and invertebrate pollinators, favor moist soils, and provide multi-season aesthetic interest. It is difficult to see from the following image, but most of the surface water from cleared portions of the farm are directed towards this swale focusing water towards the wooded areas. There is so much opportunity in this location. In connecting the wooded areas with patch habitat of trees near the main house site, remediating and slowing surface runoff from pastures, and creating a point of aesthetic interest, especially when viewed from the future farm manager home site.

Fig.5.7. Northwest at the Pond Trail site, with cattle pastures to the left, and horse pastures to the right.

The Pond Trail meadow is a phase 1 site. Its visibility, frequency of use, and ecological benefit connecting existing habitat and slowing surface runoff from grazing livestock can provide important initial impacts.

The Farm Manager House Site shown in Drawing 2, (page 75) depicts the new house orientation, surrounding planting scheme, new road alignment, and vehicular access using "Junior's Road" and a small portion of already cleared electric power line easement. This minimizes the impact of a new road crossing through the main house site and existing pastures, and also retains the desired privacy of both home sites while minimizing cost and ecological impact. It may seem limiting to not make a vehicular connection to the main house site, but the road alignment allows the main house to maintain privacy, and reduces the overall impact – both visually and ecologically – of constructing new unnecessary roads.

The home's main entrance is oriented southwest, taking advantage of the views described in the site analysis. Tree and shrub plantings provide pollinator habitat, a wide variety of bloom times and fall color, fruit for the farm manager, and an additional windbreak to the northwest.

The Farm Manager House Site will use both the "Upland Sun," and "House Envelope" meadow types. The looping road encloses most of the showier "House Envelope" species mix, with portions crossing the road and continuing on either side of the house. The remaining .75 acres will use the "Upland Sun" mix, and dashed lines depict the phased expansion as more horse pasture transitions to un-grazed meadow.

Fig.5.8. Northwest towards the Farm Manager House Site. The house will sit near the top of the rise near the tree shadow line in the background.

Fig.5.9. From the farm manager house site, looking southeast towards Two Swallows' main house, outbuildings, and food garden.


Fig.5.10. Northwest towards the Farm Manager House Site. The house will sit near the top of the rise.


Fig.5.11. West from Transco Road towards the Farm Manager House Site. Alignment of the new road will enter at right and follow the fence line to higher ground.

The new farm manager house will be only briefly visible as on travels north on Transco Road. Sited far from Transco Road and with a discrete entrance, the new farm manager's house will not compete with the prominence of the main house site, or confuse visitors locating the main entrance.

The main entrance to Two Swallows is an opportunity for meadow plantings to add aesthetic interest and act as a gateway to the main home site. The roadside swale depicted in Drawing 3, (page 76) shows relatively small phase 1 meadows using the "Swale-Sun" type, with future expansion in either direction. This site is unique from the others in its potential to remediate runoff from both road and pasture, but also the potential to use roadside right-of-ways as pollinator migration corridors. Nearly every rural property in the region has some portion of cleared roadside right-of-way that could be utilized as pollinator habitat. Although some do remain unmown, providing pollinator habitat, increasing diversity of pollinator species will reduce invasive species and increase aesthetic interest in some of our most visible landscapes. Simple and small, but highly visible meadow installments near the main farm entrance can provide an aesthetically pleasing model that can be replicated throughout the region.

Fig.5.12. South, outside of the main entrance to Two Swallows farm. The right-of-way creates an underutilized space with potential for extensive pollinator corridors.

Also utilizing the "Swale Sun" type, the field swale meadow can be seen in Drawing 4 (page 77). This area was largely covered in trees as late as the mid-1970s, (see 1973 aerial above) and is a natural swale dividing a portion of cattle pasture and pasture currently used for hay production. Appropriate tree species of *Diospyros virginiana* (American persimmon), *Cladrastis kentukea* (Yellow wood), *Cornus florida (*Dogwood), *Crataegus aestivalis* (Mayhaw), and *Chionanthus virginicus (*Fringetree) were selected for habitat, pollination, and multi-season aesthetic interest. The eastern portion is selected as an earlier phase for its proximity to the main house site, and its potential to remediate any runoff from cattle pastures.

Fig.5.13. West, in the Phase 2 field swale. The field swale will act as a habitat corridor through the middle of the farm, with trees among herbaceous plantings.

Fig.5.14. Southeast towards the future field swale meadow. The single tree to the right in the background is the location of the phase 3 meadow. Even a single tree can be important refuge for birds and invertebrate pollinators among mown or grazed fields.

The final meadow typology depicted as the partial shade meadow in Drawing 5, (page 78) is the smallest meadow in initial phases, but with the potential for great expansion. Shown in yellow, the phase 1 partial shade meadow is just .07 acres, and near to the new farm manager's house. Gradually, in future phases, the owners wish to continue to open the already fragmented mixed hardwood forest between the pastures and the spring-fed pond to the northwest. By gradually removing invasive with shade-tolerant native herbaceous species, the long-term goal is to open and extend views from the pasture all the way to the pond. In some ways this large area acts as the shade garden for the owners. Frequent walks to the pond to swim, riding horses through this area, walking dogs, and a respite from summer heat, the pond trail and wooded area between is frequently used by the owners and their visitors. As invasive herbaceous species and trees are gradually removed, native meadow species can be established at forest edges and portions of cleared area that do receive some direct sunlight.

Fig.5.15. Current aerial image of the broken mixed hardwood forest between pasture and pond in the upper-right of the image. With existing cleared areas, the long term goal is to continue removing invasive species and replace them with native herbaceous forbs and grasses.

Fig.5.16. A typical fenceline near forest edge at Two Swallows. The “Partial Shade” meadow type is intended to make use of underutilized ecotone habitats.

Aside from the Pond Trail, each meadow is intended to have a relatively small area of early establishment, followed by expansion in subsequent phases and as resources allow. As the Farm Manager’s House Site is a relatively large area with significant investment, none of the “Upland Sun,” or “House Envelope” meadow types are used in the first phase.

A phased plan is also important as maintenance and management is refined over the first few years, and a detailed maintenance guide is crucial to the success of any meadow in this region.

Establishment Method and Maintenance Regime

Following is a step-by-step guide for establishing designed meadows at Two Swallows Farm. As exhibited in the case studies above, initially there must be some eradication of existing vegetation using a combination of mechanical methods, herbicide treatment, and burning. Because there is existing vegetation throughout the Two Swallows meadows sites, and the long term history of site use contributing to the seed bank is unknown, physically disturbing the soil should be avoided to prevent erosion and competing weed seeds from reaching the soil surface.

Assistance in creating this detailed maintenance schedule was provided by Matt Whitaker through many conversations during the spring of 2016. Whitaker is a licensed landscape architect practicing in Southern Tennessee, and has extensive experience in implementing meadows in a variety of sites and scales throughout the Southeast and Mid-Atlantic region during the last 15 years.

<u>June – August of Year 1</u>

Hand spray/spot treat Johnson grass, thistle or other noxious warm season weeds with glyphosate solution or other control method before they produce seed. If seeds have formed, remove seed heads before seeds are released and dry in paper bag then burn when dry. Do not add to compost, brush piles or trash.

If areas of warm-season weed infestations are too large to spot treat use a wick application of glyphosate solution or other control method before weeds reach a height that does not allow for use of wick.

Cutting a field prior to herbicide treatment will make the treatment much less effective unless significant re-growth is allowed. Glyphosate and other herbicides use the green, fleshy leaf surfaces to enter the plant system and cannot kill via cut stems[i] or roots. More leaf cover, means more successful weed kill.

<u>September 1</u>

Perform soil test as needed depending on size of area to be converted and different soil zones. Adjust if necessary following recommendation in Soil Amendment section.

Burn, graze, hay or mow field and allow fescue and other cool season weeds to re-grow to 6-10”.

<u>October 15 – November 15</u>

Boom spray entire field with glyphosate solution preferably after hard frost to kill fescue and other cool season weeds.

If alternative method of removing unwanted vegetation is used timing of treatment will differ.

<u>November</u>

Spot spray any undesirable plants that were not eradicated with boom spray with glyphosate solution.

<u>December/January of Year 2</u>

Order seeds. Rates, species and sources will vary depending on conditions of field to be seeded: moisture level, aspect, regional context, seedbank contents, likelihood of erosion; as well as desired uses: wildlife, forage or a combination the two.

Schedule seed installation with contractor.

<u>April of Year 2</u>

Spot spray any unwanted plants that have emerged with glyphosate solution or alternative.

If significant numbers are present, treat with a second boom spray of glyphosate solution or alternative.

Burn or closely mow field to provide a clean surface for seeding and reduce unwanted seeds on the soil surface.

Rake field to remove any large stones, heavy sticks, and any litter not burned.

<u>May 7 to May 21 of Year 2</u>

Plant Seed

Seeds should be planted no more than ¼" deep into a firm, dry seedbed. When using a seed drill the height of the drill should be adjusted to ensure that at least one-third of the seed is obvious on top of the seedbed.

If seed is broadcast, the seedbed should be rolled or cultipacted[ii] after broadcasting to ensure good seed to soil contact. Do not disk or harrow to cover the seed.

During the initial period of establishment all vehicle and pedestrian traffic should be restricted in seeded areas.

<u>June – November of Year 2</u>

The field should be monitored for weeds on a minimum monthly basis. Vegetation should not be allowed to exceed 14 inched in height. As vegetation approaches 14” the field should be mown back to 6-8” stubble.

As summer progresses the mower height can be raised to mow above NWSG seedlings. It may be difficult to differentiate between annual grass weeds and the NWSG in the first year. At the end of this first year, the final growth should be left to protect the seedlings over winter.

<u>March - April of Year 3</u>

Evaluate field and determine if a burn is appropriate. If not burned, the meadow should be mown close to the ground, raked and clippings removed.

Burning stimulates germination of dormant seeds, growth of the plants that germinated the first year and reduces weed seeds and plants.

<u>May – September of Year 3</u>

Spot treat noxious weeds with glyphosate or hand dig. If weeds persist continue to mow the meadow to prevent weeds from out competing natives and weed seed heads from forming.

The establishment and maintenance schedule relies heavily on glyphosate herbicide to effectively and quickly eradicate unwanted weeds. As mentioned following the discussion of the case studies, most designed meadows implemented by landscape architects are established initially with repeated applications of herbicide. While the Two Swallows client prefers to not use glyphosate, several natural herbicide options exist for removing unwanted vegetation. Many natural herbicides use salt or vinegar solutions, and a small amount of surfactant (often dish soap). Acetic acid found in vinegar removes the plant’s waxy cuticle, causing it to over-transpire and die. Although much more labor intensive, smothering unwanted vegetation by depriving it of light and water is another approach.

Due to the initial costs of establishing a meadow, whether in labor or monetary expense, the implementation plan for Piedmont meadow sites at Two Swallows has been phased gradually to test all four typologies on sites amounting to less than one acre in the initial phase. It will take years of ongoing observation and alteration of the maintenance regime to find a successful routine for each site.

Selecting for Aesthetics

As discussed in the Introduction, the primary assessment metric within the scope of this thesis focuses on the aesthetic. Ecosystem services are inherent, yet the human focus is on management regimes that will lead to meadows with multi-season, showy native herbaceous grasses and forbs. As an example, the season of interest color chart located in the Appendix (p.79) is meant as a general guide when selecting a meadow color palette and species' seasonal color. The chart, as with the species plant lists (pp.80-87) are not intended as a planting schedule but a list of native meadow species appropriate for each meadow type. One should first begin with aforementioned grass:forb ratios, and select to sow 12-13lbs of pure live seed/acre for this region. Using the House Envelope species list, the chart provides a quick visual reference when selecting appropriate meadow species based on their height and color throughout the year.

Chapter 6

Conclusion

The total area of all proposed meadow typologies and phases is less than 2.5 acres. The initial challenge from the client was to incorporate these meadows throughout the landscape while taking as little land out of productive pasture as possible. The primary goal of this thesis was to develop and implement four meadow typologies with an aesthetic and functional design approach, using plant species attractive to both humans and wild pollinators. Critical to the success of four different meadows was a management regime for this region that maintained a desirable appearance with the potential to supplant a conventional planting plan.

This resulted in relatively small alterations on the landscape, though the intersecting motivations and benefits from incorporating this type of landscape reaches beyond small alterations in a rural setting. Returning to Nassauer's *Cues to Care* and how that manifests in the rural Georgia Piedmont, simple boundaries of forest edge, fence line, swale, and outbuildings provide visual organization in the landscape. The proposed meadows may seem relatively small, but their location and size are strategic as they act as habitat corridors, distinguish and frame farm uses, and enrich views and the human experience throughout the farm.

The very clear and urgent need for rural pollinator habitat was one motivation for this thesis. The unfortunate "production reduction cycle," where loss of wild pollinator habitat produces fewer pollinators, resulting in reduced crop yields, and increasing demand for agricultural lands is entirely avoidable with small patches and corridors of land devoted to native pollinator habitat.

The challenge of creating a successful seed mix and maintenance schedule of meadow plants on the Georgia Piedmont was attractive after often hearing of their improbability and lack of success in this region. The surge in popularity of meadow plantings, (in increasingly smaller areas) with increasing aesthetic interest speaks to a need for best management practices for their implementation in the Southeast. With the incredible array of rare and endemic species within the isolated Southern prairies, it is especially important to develop successful precedents that reinforce the significance of place through the species used.

As mentioned in Chapter 4, the case studies were selected because of their similar climate and soil characteristics, detailed record of establishment and maintenance, and their present success as grasslands. The primary challenges of establishing and maintaining "stable" meadow communities in the South (setting it apart from other regions in the U.S.) are the seeming relentless ability of invasives to out-compete desirable meadow grasses and forbs, and the initial difficulty of clearing the land for establishment. The case studies focus on these two aspects - of pernicious weeds, and the meadows' "story" of establishment and invasive management eradication – and less on aesthetic-based species selections. This is due in part to incomplete species lists with each case study, but is also a result of the novelty in designing a southeastern meadow with such a wide variety of flowering forbs. The case studies are relevant and critical as establishment and management precedents, though the aesthetic focus of this work deviates from those in order to supplant conventional ornamental planting plans. Additionally, many of the species used in the case studies provide successful examples of what to use, though the array of species endemic to the South, (and included in the lists of this work), enriches and reinforces the significance of place.

My own time spent on the Two Swallows site established its significance for me, and the cleared and fallow farmland was an important motivation in my attraction to naturalistic, meadow landscapes. The farm is on high ground with no shortage of cleared interstitial spaces to incorporate landscapes that reduce maintenance and speak to the land ethic of the farm owners.

Though not the goal or main focus of this thesis, the impetus for designed meadow plantings came out of the client's desire to site a farm manager's house on the farm property, proximate to the main house while allowing both home sites to maintain their privacy. Mentioned briefly above, the original stipulations for siting the farm manager's house called for a naturalistic native perennial planting design and siting that speaks to the history of the farm. This was accomplished in two ways: using historic field terracing to site the future farm manager's house, and using endemic and rare species found only in the Southeast in species lists for each meadow.

The meadow typologies are not random. They are influenced by apparent needs on site: a naturalistic planting plan surrounding the new farm manager's house; a landscape that speaks to the history of the site; and continuing the landscape vocabulary and beauty found in the de facto grasslands on the property caused by the pipeline and power line easements. Seeing the farm in all seasons and times of day, viewing historical photographs of crop fields, and working on the site for multiple years, the individual meadow locations and their future expansion became clear after siting the Farm Manager's house.

Existing grasslands in the Southeast need no encouragement or special management, but without careful management and species selection, the Southern grassland is temporary and not realizing its full potential to serve wildlife and human needs. William Gilpin wrote that beautiful objects are "those which please the eye in their natural state (Gilpin, 1792). While never entirely *natural*, the meadow designs presented here reflect the location that makes them unique. Rather than "biotope planting," "wild-looking," or any other currently favored term for naturalistic planting, the meadows at Two Swallows are intended to reflect the significance of place. With native, rare, and some endemic Southeastern species, along with embedded species found for years in the power easement or pipeline clearing, the work intends to create a landscape that is managed, not controlled, and that clearly communicates the unique composition and "southern palette" of rural Piedmont meadow aesthetic.

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APPENDIX


Two Swallows Property
N
Map 1
135
acres total
40
acres pasture &
fallow fields
3
acres home site;
food, flower gardens;
outbuildings


pond
"Juniors Road"
power easement
future pasture expansion
horse pasture
horse pasture
pond trail
cattle pasture
paddock
food garden
main barn
toolshed / chicken house
house
implement access
Transco Road
Site Inventory
Map 2
N
1′
100′
300′


pond
"Junior's Road"
power easement
view
future pasture expansion
highground
view
hidden from highway
drainage
drainage
intense grazing
pond trail
ridge
paddock
ridge
view
food garden
highground
main barn
toolshed / chicken house
house
implement access
Transco Road
Site Analysis
Map 3
N
1'
100'
300'


Phase 1 swale-sun meadow: .55 acres
Cercis canadensis - Redbud
Liriodendron tulipifera - Tulip Poplar
Cladrastis kentukea - Yellowwood
Chionanthus virginicus - Fringetree
Nyssa sylvatica - Black Tupelo
Pond Trail
Drawing 1
1"=60'
N
0'
60'
120'


Cornus florida - Dogwood
Fothergilla major
Phase 2 upland meadow:
.21 acres
Malus spp. - Apple
Cornus florida - Dogwood
Juniperus virginiana - Red Cedar
Phase 2 upland meadow: .29 acres
Phase 3 upland meadow: .082 acres
Phase 2 "showy" meadow: .29 acres
Phase 4 upland meadow: .16 acres
Cercis canadensis - Redbud
Diospyros virginiana - American Persimmon
Carya tomentosa - Mockernut Hickory
Farm Manager
House Site
Drawing 2
1"=60'
N
0'
60'
120'


Phase 2 swale sun meadow: .03 acres
Phase 1 swale sun meadow: .048 acres
Phase 1 swale sun meadow: .045 acres
Phase 2 swale sun meadow: .03 acres
Roadside Swale
Drawing 3
1″=60′
N
0′
60′
120′


Phase 3 swale sun meadow: .21 acres
Nyssa sylvatica - Black Tupelo
Cornus florida - Dogwood
Cladrastis kentukea - Yellowwood
Acer rubrum - Red Maple
Nyssa sylvatica - Black Tupelo
Chionanthus virginicus - Fringetree
Phase 2 swale sun meadow: .26
Crataegus aestivalis - Mayhaw
Diospyros virginiana - American Persimmon
Cladrastis kentukea - Yellowwood
Field Swale
Drawing 4
1″=60′
N
0′
60′
120′


Phase 1 partial shade meadow: .07 acres
Phase 3-4 partial shade meadow expansion
throughout woods towards spring pond.
Partial-Shade
Drawing 5
N
1″=60′
0′
60′
120′

Season of Interest Color Chart

House Envelope Showy native herbaceous species favoring dry-medium soils & full sun			MONTH											
Botanical Name	Common Name	Height	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
Grasses														
Andropogon gerardii	Big Bluestem	36-72"												
Andropogon ternarius	Spilt Beard Bluestem	18-48"												
Andropogon virginicus	Broomsedge Bluestem	24-48"												
Bouteloua curtipendula	Sideoats Grama	18-30"												
Calamagrostis canadensis	Blue Joint Grass	40-48"												
Carex aurea	Golden Sedge	12"												
Chasmanthium latifolium	River Oats	24-60"												
Deschampsia cespitosa	Tufted Hair Grass	12-36"												
Elymus canadensis	Canada Wild Rye	24-60"												
Elymus virginicus	Virginia Wild Rye	36-48"												
Eragrostis spectabilis	Purple Love Grass	16-32"												
Muhlenbergia capillaris	Pink Hair Grass	36-48"												
Panicum virgatum 'Prairie Sky'	Blue Switchgrass	48-60"												
Schizachyrium scoparium	Little Blue Stem	30-60"												
Sorghastrum nutans	Indiangrass	96"												
Sporobolus heterolepis	Prairie Dropseed	24-36"												
Tridens flavus	Purple Top	32-60"												
Botanical Name	Common Name	Height												
Forbs														
Asclepias purpurascens Linnaeus	Purple Milkweed	18-40"												
Asclepias tuberosa	Butterfly Milkweed	12-30"												
Aster ericoides	Heath Aster / White Heath Aster	24"												
Aster dumosus	Bushy Aster	24-54"												
Baptisia australis	Blue Wild Indigo	36-48"												
Boltonia asteroides	False Aster	60-72"												
Coreopsis tinctoria	Golden Tickseed	24-48"												
Coreopsis verticillata 'Zagreb'	Threadleaf coreopsis	12-18"												
Echinacea pallida	Pale Purple Coneflower	24-36"												
Echinacea simulata	Wavy-leaf purple Coneflower	30-36:												
Eryngium yuccifolium	Button eryngo / Rattlesnake Master	48-60"												
Eriophorum virginicum	Tawny cottongrass	12-36"												
Heliopsis helianthoides	Smooth Ox eye	36-72"												
Liatris spicata	Blazing Star	24-48"												
Lobelia cardinalis	Cardinalflower	24-60"												
Lobelia siphilitica	Great Blue Lobelia	24-36"												
Mertensia virginica	Virginia Bluebells	18-24"												
Oenothera speciosa	White Evening Primrose	9-24"												
Parthenium integrifolium	Wild Quinine	24-48"												
Penstemon dissectus	Cutleaf Beardtongue	12-16"												
Pycnanthemum virginianum	Mountain Mint	36"												
Pycnanthemum flexuosum	Appalachian mountain mint	24-36"												
Ratibida pinnata	Yellow Coneflower	60"												
Rudbeckia triloba	Browneyed Susan	24-36"												
Sanguisorba canadensis	American Burnet	72"												
Silene polypetala (syn.S catesbaei)	Fringed Campion	16"												
Silene stellata	Starry Campion	12-36"												
Silphium asteriscus	Starry Rosinweed	24-60"												
Solidago odora	Anise Scented Goldenrod	12-24"												
Solidago rigida	Stiff Goldenrod	36-60"												
Solidago nemoralis	Old Field Goldenrod	6-24"												
Solidago speciosa	Showy Goldenrod	24-36"												
Stenaria nigricans	Diamondflowers	20"												
Veronicastrum virginicum	Culver's Root	48-84"												
Veronia glauca	Upland ironweed	36-60"												
Vernonia noveboracensis	New York Ironweed	48-72"												
Thalictrum dioicum	Early Meadowrue	12-24"												
Uvularia grandiflora	Bellwort	12-24"												
Veronicastrum virginicum	'Lavender Towers' Culvers Root	24-36"												
Zizia aurea	Golden Alexanders	12-24"												

Upland-Sun native herbaceous species favoring dry soiles & full-sun					
Botanical Name	Common Name	Height	Bloom time	Color	
Grasses					
Agrostis hyemalis	Winter Bentgrass	<24"	Apr-Nov	green	
Agrostis perennans	Autumn Bentgrass	12-30"	Jul-Sept		
Andropogon gerardii	Big Bluestem	36-72"	Jul-Oct	green. red in fall	
Andropogon ternarius	Spilt Beard Bluestem	18-48"	Oct-Nov	bronze, white	
Andropogon virginicus	Broomsedge Bluestem	24-48"	Oct.-Nov	gold	
Bouteloua curtipendula	Sideoats Grama	18-30"	Jul-Sept	green, gold	
Aristida oligantha	Prairie Three Awn	8-24"	Aug-Oct		
Aristida dichotoma	Three Awn Grass	<28"	Aug-Oct	yellow-violet	
Danthonia spicata	Northern Oat Grass / Poverty Grass	4-30"	May-June		C3
Dichanthelium sphaerocarpon	Roundseed Panicgrass	6-24"	Jun-Oct	green	
Elymus canadensis	Canada Wild Rye	24-60"	Jul-Oct	green, yellow	C3. Great nurse crop. Rapid establishment, short-lived, not competitive with other grasses.
Elymus virginicus	Virginia Wild Rye	36-48"	June-Oct		C3
Eragrostis hirsuta	Bigtop Love Grass	24-50"	Jul-Oct	reddish	
Eragrostis spectabilis	Purple Love Grass	16-32"	Aug-Oct	violet	
Gymnopogon ambiguus	Beard Grass	12-24"	Aug-Oct		
Muhlenbergia capillaris	Pink Hair Grass	36-48"	Aug-Oct	pink, purple	taller than *E. spectabilis*. deer resistant
Panicum anceps	Beaked Panicgrass	12-48"	Jul-Oct		
Saccharum alopecuroides	Silver Plume Grass	120"	Oct-Nov	bronze, silver	
Schizachyrium scoparium	Little Blue Stem	30-60"	Aug-Oct.		
Sorghastrum nutans	Indiangrass	96"	Sept-Oct.	red-yellow	
Sphenopholis obtusata	Wedge Grass	8-30"	Apr-May		
Sporobolus heterolepis	Prairie Dropseed	24-36"	Aug-Oct	pink; brown-tint	tolerates heavy clay soils; fragrant; attracts birds; deer resistant
Tridens flavus	Purple Top	32-60"	Jul-Oct.	violet	
Botanical Name	Common Name	Height	Bloom time	Color	
Forbs					
Asclepias syriaca	Common Milkweed	24-36"	June-Aug	pink, mauve	butterflies, deer tolerant
Asclepias tuberosa	Butterfly Milkweed	12-30"	June-Aug	yellow-orange	deer tolerant; butterflies
Agastache foeniculum	Lavender Hyssop	12-36"	June-Sept	purple	deer tolerant; fragrant
Baptisia australis	Blue Wild Indigo	36-48"	May-Jun	blue	
Chamaecrista fasciculata	Partridge Pea	24"	July-Sept	yellow	
Coreopsis auriculata 'Nana'	Ear-leaved tickseed	6-10"	May-June	yellow	butterflies, deer tolerant
Coreopsis tinctoria	Golden Tickseed	24-48"	Jun-Sept	yellow-red	butterflies; deer resistant
Coreopsis verticillata 'Zagreb'	Threadleaf Coreopsis	12-18"	May-June	yellow	deer resistant
Echinacea pallida	Pale Purple Coneflower	24-36"	June-July	pale purple	deer tolerant
Echinacea simulata	Wavy-leaf purple Coneflower	30-36:	June-July	pale purple	rare; native to GA
Heliopsis helianthoides	Smooth Ox eye	36-72"	June-Aug	orange-yellow	butterflies
Ratibida pinnata	Yellow Coneflower	60"	July-Sept	yellow	GA Eocene Chalk Prairie
Rudbeckia triloba	Browneyed Susan	24-36"	July-Oct	yellow, brown	deer tolerant
Penstemon dissectus	Cutleaf Beardtongue	12-16"	April-May	pink,purple,white	rare
Parthenium integrifolium	Wild Quinine	24-48"	May-Aug	white	fragrant

Upland-Sun native herbaceous species favoring dry soiles & full-sun					
Pycnanthemum virginianum	Mountain Mint	36"	June-Sept	white	bees, butterflies
Pycnanthemum muticum	Clustered Mountain Mint	24"	Aug-Sept	white	butterflies, deer resistant, fragrant
Scutellaria drummondii	Drummond's Skullcap	12	Mar-May	white, purple	rare
Silene stellata	Starry Campion	12-36"	May-Aug	white	pollinators; deep taproot
Silphium asteriscus	Starry Rosinweed	24-60"	May-Sept	yellow	rare; butterflies/pollinators
Solidago rigida	Stiff Goldenrod	36-60"	Aug-Sept	yellow	butterflies, pollinators; deer resistant
Solidago nemoralis	Old Field Goldenrod	6-24"	July-Sept	lemon yellow	GA Eocene Chalk Prairie
Solidago speciosa	Showy Goldenrod	24-36"	July-Sept	yellow	butterflies, pollinators; deer resistant
Symphyotrichum cordifolium	Blue Wood Aster				
Veronia glauca	Upland Ironweed	36-60"	Aug-Sept	purple	rare ; butterflies

Swale - Sun native herbaceous species favoring wetter soils in full-sun					
Botanical Name	Common Name	Height	Bloom time	Color	
Grasses					
Andropogon glomeratus	Bushy Bluestem	24-60"	July-Oct		
Agrostis perennans	Autumn Bentgrass	12-30"	Jul-Sept		
Andropogon virginicus	Broomsedge Bluestem	24-48"	Oct.-Nov		
Chasmanthium latifolium	River Oats	24-60"	Aug-Oct	green, straw	C3. Can be aggressive
Calamagrostis canadensis	Blue Joint Grass	40-48"	June-Aug	green	C3
Carex aurea	Golden Sedge	12"	Apr-Jun	green	butterflies
Carex conoidea	Openfield Sedge	18"	May-Jun		
Carex crinata	Fringed Sedge	30"	May-Jun	green	
Carex lupulina	Hop Sedge	24"	June-Aug	green	
Carex scoparia	Broom Sedge	24"	June-Jul	green	
Carex squarrosa	Squarrose Sedge	12-18"	June-Aug	green	
Carex typhina	Common Cattail Sedge	12"	June-Aug		
Carex vulpinoidea	Fox Sedge	12-36"	May-June	brown-bronze	FACW. Suther Prairie
Eragrastis refracta	Love Grass	12-40"	July-Oct	reddish	
Juncus effusus	Common Rush	24-48"	June-Aug	yellowish-green	
Eriophorum virginicum	Tawny cottongrass	12-36"	June-Sept	white, green	
Panicum flexile	Slender Panic Grass	12-36"	Jul-Oct		
Panicum rigidulum	Redtop panicgrass	36-40"	Aug-Oct	green	
Panicum virgatum 'Prairie Sky'	Blue Switchgrass	48-60"	Aug-Oct	gold - dark red	
Phalaris arundinacea	Reed Canarygrass	36-72"	June-July	reddish	
Sorghastrum nutans	Indiangrass	96"	Sept-Oct.	red-yellow	
Tripsacum dactyloides	Eastern gamagrass	36-72"	Apr-June	green; yellow	deer will eat. attracts butterflies. Suther Prairie
Botanical Name	Common Name	Height	Bloom time	Color	
Forbs					
Aletris farinosa	Colic Root	18-36"	Apr-Jun, Jul-Aug	white	
Apocynum cannabinum	Indian hemp	36-72"	May-Aug	white, green	butterflies. Suther Prairie
Aster dumosus	Bushy Aster	24-54"	Aug-Oct.	white, blue, lav	
Aquilegia canadensis 'Little Lanterns'	Dwarf wild columbine	12-18"	Apr-Jun	red	deer resistant, hummingbirds
Baptisia australis	Blue Wild Indigo	36-48"	May-Jun	blue	
Cephalanthus occidentalis	Buttonbush	60-144"	June	white	butterflies. Shrub habit. Suther Prairie
Dryopteris x australis	Dixie Woodfern	36-48"		green	deer resistant
Eupatorium fistulosum	Joe Pye Weed	48-84"	Jul-Sept	rose	
Eupatorium maculatum	Spotted Joe Pye Weed	48-60"	Jul-Sept	pink	
Eupatorium perfoliatum	Common Boneset	36-72"	Aug-Sept	white	bees, butterflies
Hypericum erythraeae	Georgia St. John's-Wort	16-39"	June-Sept	yellow	fragrant
Liatris spicata	Blazing Star	24-48"	July-Aug	red-purple	
Lobelia cardinalis	Cardinalflower	24-60"	July-Sept	red	
Lobelia siphilitica	Great Blue Lobelia	24-36"	July-Sept	blue	
Mertensia virginica	Virginia Bluebells	18-24"	Mar-Apr	lt. blue	deer resistant
Parthenium integrifolium	Wild Quinine	48"	May-Oct	white	medicinal
Penstemon laevigatus	Eastern smooth beardtongue	24"	May-Jul	pale purple	
Pycnanthemum flexuosum	Appalachian mountain mint	24-36"	Aug-Oct	white	butterflies, deer resistant, fragrant

Swale - Sun native herbaceous species favoring wetter soils in full-sun					
Botanical Name	Common Name	Height	Bloom time	Color	
Pycnanthemum muticum	Clustered Mountain Mint	24”	Aug-Sept	white	butterflies, deer resistant, fragrant
Pycnanthemum virginianum	Virginia Mountain Mint	36”	June-Sept	white	bees, butterflies
Rhexia virginica	Handsome Harry	24-36”	June-Oct	pink	
Rudbeckia lacinata ‘Autumn Sun’	Cutleaf Coneflower	60-72”	Aug-Sept	yellow	deer resistant
Sanguisorba canadensis	American Burnet	72”	Aug-Oct	white	
Sisyrinchium angustifolium	Blue-eyed Grass	18-24”	April-May	lt. blue	attracts native bees
Verbesina alternifolia	Wingstem	48-96”	Aug-Oct	yellow	butterflies
Veronicastrum virginicum	Culver’s Root	48-84”	May-Aug	white-pale blue	
Vernonia noveboracensis	New York Ironweed	48-72”	Aug-Sept	purple	

Partial Shade native herbaceous species favoring dry-medium soils & partial shade					
Botanical Name	Common Name	Height	Bloom time	Color	
Grasses					
Andropogon glomeratus	Bushy Bluestem	24-60"	July-Oct		
Andropogon virginicus	Broomsedge Bluestem	24-48"	Oct.-Nov		
Calamagrostis canadensis	Blue Joint Grass	40-48"	June-Aug	green	C3
Carex aurea	Golden Sedge	12"	Apr-June	green	butterflies
Carex crinata	Fringed Sedge	30"	May-June	green	
Chasmanthium latifolium	River Oats	24-60"	Aug-Oct	green, straw	C3. Can be aggressive
Deschampsia cespitosa	Tufted Hairgrass	12-36"	June	straw-gold	C3
Deschampsia flexuosa	Wavy Hair Grass	6-18"	July-Sept	apricot	cool season, thrives in dry shade
Elymus virginicus	Virginia Wildrye	24-48"	Mar-May	yellow	C3
Sorghastrum nutans	Indiangrass	96"	Sept-Oct.	red-yellow	
Tripsacum dactyloides	Eastern Gamagrass	36-72"	Apr-June	green; yellow	deer will eat. attracts butterflies. Suther Prairie
Botanical Name	Common Name	Height	Bloom time	Color	
Forbs					
Aster cordifolius	Blue Wood Aster	24-36"	Aug-Sept	blue	butterflies/birds
Aster divaricatus	White Woodland Aster	24-48"	Aug-Sept	white	butterflies/birds
Aquilegia canadensis 'Little Lanterns'	dwarf wild columbine	12-18"	Apr-Jun	red	deer resistant, hummingbirds
Aster macrophyllus	Big Leaf Aster	12-24"	Aug-Sept	white,blue	butterflies/birds; deer resistant
Aruncus dioicus	Goat's Beard	36-72"	May-Jun	white	butterflies/pollinators
Eurybia divaricata	White Wood Aster	12-30"	Aug-Sept	white, yellow	butterflies, heavy shade tolerant
Campanula americana	Tall Bellflower	24-60"	July-Sept	purple	hummingbirds
Carex pensylvanica	Pennsylvania Sedge	6-12"	Apr-Jun	straw-gold	deer resistant
Carex radiata	Eastern Star Sedge	12-24"	May-Jun	straw-gold	birds; deer resistant
Dryopteris x australis	Dixie woodfern	36-48"		green	deer resistant
Dryopteris marginalis	Marginal Wood Fern	18-24"		green	heavy shade tolerant
Eupatorium coelestinum	Mistflower	12-36"	Jul-Oct	lavender, blue	butterflies/pollinators
Eupatorium purpureum	Sweet Joe Pye Weed	48-72"	Aug-Sep	pink	butterflies/pollinators; deer resistant
Dennstaedtia punctilobula	Hay-scented fern	18-24"	non-flowering	green	fragrant, heavy shade tolerant
Helianthus strumosus	Woodland Sunflower	36-60"	Aug-Oct	yellow	butterflies/pollinators; deer resistant
Geranium maculatum	Wild Geranium	18-24"	April-May	pink, lilac	deer and rabbit resistant
Iris cristata	Dwarf Crested Iris	6-9"	April	pale blue	ground cover; deer resistant
Lobelia siphilitica	Great Blue Lobelia	24-36"	July-Sept	blue	
Mertensia virginica	Virginia Bluebells	18-24"	Mar-Apr	lt. blue	deer resistant
Osmunda cinnamomea	Cinnamon Fern	36-60"	Jun-Aug	green	deer resistant
Phlox divaricata	Wild Blue Phlox	12-24"	May-June	blue	butterflies/pollinators, birds, hummingbirds; deer resistant
Polygonatum biflorum	Solomon's Seal	12-36"	May-June	white, cream	birds
Prenanthes barbata	Barbed Rattlesnake Root	18-60"	Sept-Oct	white	rare. bee pollination
Pycnanthemum flexuosum	Appalachian mountain mint	24-36"	Aug-Oct	white	butterflies, deer resistant, fragrant
Pycnanthemum muticum	Clustered mountain mint	24:	Aug-Sept	white	butterflies, deer resistant, fragrant
Sanguinaria canadensis	Bloodroot	3-12"	Apr-May	white	deer resistant
Sisyrinchium angustifolium	Blue-eyed Grass	18-24"	April-May	lt. blue	attracts native bees

Partial Shade native herbaceous species favoring dry-medium soils & partial shade					
Botanical Name	Common Name	Height	Bloom time	Color	
Smilacina racemosa	Solomon's Plume	12-36"	May-June	white	birds
Solidago odora	Anise Scented Goldenrod	12-24"	Aug-Sep	yellow	butterflies/pollinators, birds
Tiarella cordifolia	Foam Flower	9-12"	May	white, pink	deer and rabbit tolerant
Thalictrum dioicum	Early Meadowrue	12-24"	May-June	cream, straw-gold	
Trillium grandiflorum	Wood Lily	12-18"	April-June	White	showy
Uvularia grandiflora	Bellwort	12-24"	May-June	yellow	
Veronicastrum virginicum	Culver's Root	36-72"	Jul-Aug	white	pollinators
Zizia aurea	Golden Alexanders	12-24"	May-July	yellow	butterflies/pollinators; deer resistant

House Envelope Showy native herbaceous species favoring dry-medium soils & full sun					
Botanical Name	Common Name	Height	Bloom time	Color	
Grasses					
Andropogon gerardii	Big Bluestem	36-72″	July-Oct	red in fall	
Andropogon ternarius	Spilt Beard Bluestem	18-48″	Oct-Nov	bronze, white	
Andropogon virginicus	Broomsedge Bluestem	24-48″	Oct.-Nov	gold	
Bouteloua curtipendula	Sideoats Grama	18-30″	July-Sept	green, gold	
Calamagrostis canadensis	Blue Joint Grass	40-48″	June-Aug	green	C3
Carex aurea	Golden Sedge	12″	Apr-June	green	butterflies
Chasmanthium latifolium	River Oats	24-60″	Aug-Oct	green, straw	can be aggressive
Deschampsia cespitosa	Tufted Hair Grass	12-36″	June	straw-gold	C3
Elymus canadensis	Canada Wild Rye	24-60″	July-Oct	green, yellow	C3. Great nurse crop. Rapid establishment, short-lived, not competitive with other grasses.
Elymus virginicus	Virginia Wild Rye	36-48″	June-Oct	red	C3
Eragrostis spectabilis	Purple Love Grass	16-32″	Aug-Oct	violet	
Muhlenbergia capillaris	Pink Hair Grass	36-48″	Aug-Oct	Pink, purple	taller than *E. spectabilis*. deer resistant
Panicum virgatum 'Prairie Sky'	Blue Switchgrass	48-60″	Aug-Oct	gold - dark red	
Schizachyrium scoparium	Little Blue Stem	30-60″	Aug-Oct.	gold-red	
Sorghastrum nutans	Indiangrass	96″	Sept-Oct.	red-yellow	
Sporobolus heterolepis	Prairie Dropseed	24-36″	Aug-Oct	pink; brown-tint	tolerates heavy clay soils; fragrant; attracts birds; deer resistant
Tridens flavus	Purple Top	32-60″	July-Oct.	violet	
Botanical Name	Common Name	Height	Bloom time	Color	
Forbs					
Asclepias purpurascens Linnaeus	Purple Milkweed	18-40″	June-Aug	purple	rare. reliant on insect pollination
Asclepias tuberosa	Butterfly Milkweed	12-30″	June-Aug	yellow-orange	deer resistant; butterflies
Aster ericoides	Heath Aster / White Heath Aster	24″	Aug-Oct	white	
Aster dumosus	Bushy Aster	24-54″	Aug-Oct.	white, blue, lav	
Baptisia australis	Blue Wild Indigo	36-48″	May-Jun	blue	
Boltonia asteroides	False Aster	60-72″	Aug-Sept	white, lilac, yellow	clay soil
Coreopsis tinctoria	Golden Tickseed	24-48″	Jun-Sept	yellow-red	butterflies; deer resistant
Coreopsis verticillata 'Zagreb'	Threadleaf coreopsis	12-18″	May-June	yellow	deer tolerant
Echinacea pallida	Pale Purple Coneflower	24-36″	June-July	pale purple	deer tolerant
Echinacea simulata	Wavy-leaf purple Coneflower	30-36:	June-July	pale purple	rare; native to GA
Eryngium yuccifolium	Button eryngo / Rattlesnake Master	48-60″	Aug-Sept	lt. blue	butterflies; deer tolerant
Eriophorum virginicum	Tawny cottongrass	12-36″	June-Sept	white, green	
Heliopsis helianthoides	Smooth Ox eye	36-72″	June-Aug	orange-yellow	butterflies
Liatris spicata	Blazing Star	24-48″	July-Aug	red-purple	
Lobelia cardinalis	Cardinalflower	24-60″	July-Sept	red	
Lobelia siphilitica	Great Blue Lobelia	24-36″	July-Sept	blue	
Mertensia virginica	Virginia Bluebells	18-24″	Mar-Apr	lt. blue	deer resistant
Oenothera speciosa	White Evening Primrose	9-24″	May-July	white, rosy pink	fragrant
Parthenium integrifolium	Wild Quinine	24-48″	May-Aug	white	fragrant

House Envelope Showy native herbaceous species favoring dry-medium soils & full sun					
Botanical Name	Common Name	Height	Bloom time	Color	
Penstemon dissectus	Cutleaf Beardtongue	12-16"	April-May	pink,purple,white	rare
Pycnanthemum virginianum	Mountain Mint	36"	June-Sept	white	bees, butterflies
Pycnanthemum flexuosum	Appalachian mountain mint	24-36"	Aug-Oct	white	butterflies, deer resistant, fragrant
Ratibida pinnata	Yellow Coneflower	60"	July-Sept	yellow	GA Eocene Chalk Prairie
Rudbeckia triloba	Browneyed Susan	24-36"	July-Oct	yellow, brown	deer tolerant
Sanguisorba canadensis	American Burnet	72"	Aug-Oct	white	
Silene polypetala (syn.S catesbaei)	Fringed Campion	16"	March-May	pink	rare
Silene stellata	Starry Campion	12-36"	May-Aug	white	pollinators; deep taproot
Silphium asteriscus	Starry Rosinweed	24-60"	May-Sept	yellow	rare; butterflies/pollinators
Solidago odora	Anise Scented Goldenrod	12-24"	Aug-Sep	yellow	butterflies/pollinators, birds
Solidago rigida	Stiff Goldenrod	36-60"	Aug-Sept	yellow	butterflies; pollinators; deer resistant
Solidago nemoralis	Old Field Goldenrod	6-24"	July-Sept	lemon yellow	GA Eocene Chalk Prairie
Solidago speciosa	Showy Goldenrod	24-36"	July-Sept	yellow	butterflies, pollinators; deer resistant
Stenaria nigricans	Diamondflowers	20"	Apr-Nov	white, pink	GA Eocene Chalk Prairie
Veronicastrum virginicum	Culver's Root	48-84"	May-Aug	white-pale blue	
Veronia glauca	Upland ironweed	36-60"	Aug-Sept	purple	rare; butterflies
Vernonia noveboracensis	New York Ironweed	48-72"	Aug-Sept	purple	
Thalictrum dioicum	Early Meadowrue	12-24"	May-June	cream, straw-gold	
Uvularia grandiflora	Bellwort	12-24"	May-June	yellow	
Veronicastrum virginicum	Culver's Root	36-72"	July-Aug	white	pollinators
Zizia aurea	Golden Alexanders	12-24"	May-July	yellow	butterflies/pollinators; deer resistant