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# Interpreting the Ursinus Food Forest: Visualizing, Designing, and Realizing Signage at the Whittaker Environmental Research Station (WERS)

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In the fall Ursinus will begin planting the initial species of its food forest on two acres at the Whittaker Environmental Research Station (WERS), an agricultural field currently characterized by livestock forage species, just off campus. By increasing biodiversity at the site and implementing a design that mimics the structure of a healthy forest ecosystem, this food forest intends to improve the wider ecosystem's health and resilience, while also providing the local community with a source of harvestable food and craft materials. As the system matures and becomes available to the public, interpretive materials will become imperative to ensuring visitors interact with the site in a safe, appropriate, and meaningful manner. Successful interpretation should see visitors come away from the site with a deeper understanding of the system's functioning, direct and indirect benefits to humans and wildlife, and ideally a greater appreciation for and willingness to care for the surrounding ecosystem. This project develops an interpretive signage protocol that includes a) a conceptual framework for understanding the food forest and its multiple goals, b) an inventory of specific signage topics (i.e. interpretable elements) and their placement within the site's current layout, and c) the design parameters that should govern the textual clarity and visual appearance of these signs. The protocol is accompanied by finished signage models that illustrate these goals.

*Keywords:* food forest, interpretive signage, protocol, multifunctionality, land use

In the fall Ursinus College will begin planting the initial species of its new *food forest* on two acres at the Robert and Shurley Knaefler Whittaker Environmental Research Station (WERS), an agricultural field currently characterized by livestock forage species. WERS is an agriculturally preserved parcel in the nearby Borough of Trappe that is integral to the departments of Environmental Studies and Biology's emerging emphasis on agroecological approaches to land management and the College's new Food Studies minor. Activities at WERS will also support the College's three centers (i.e. Parlee, U-Imagine, and Melrose) and the Peace Corps Prep program. Through experiential learning and field research, Ursinus students from diverse backgrounds and majors will have the opportunity to learn about the benefits of land management centered on multifunctionality.

Multifunctional agroecological systems seek to increase biodiversity at the site by implementing design that mimic the structure of healthy ecosystems. In the case of the WERS food forest, we seek to mimic a forest ecosystem, which ideally should improve the wider ecosystem's health and resilience, while also providing the local community with a source of harvestable food and craft materials. As the system matures and becomes available to the public, interpretive materials will become imperative to ensuring visitors interact with the site in a safe, appropriate, and meaningful manner. Successful interpretation should see visitors come away from the site with a deeper understanding of the system's functioning, direct and indirect benefits to humans and wildlife, and ideally a greater appreciation for and willingness to care for the surrounding ecosystem.

Food forests are relatively new as land use practices go, therefore the literature about interpreting these specific landscapes in an informative and impactful manner is sparse. As such, the goals of this interpretive signage protocol are threefold. The document includes a) a conceptual framework for understanding the food forest and its multiple goals, b) an inventory of specific signage topics (i.e. interpretable features) and their placement within the site's current layout, and c) the design parameters that should govern the textual clarity and visual appearance of these signs. The protocol concludes with a list of potential manufacturing options and price estimates for each signage type, and with suggestions for improving the signage process beyond what is presented here. The protocol is accompanied by models of finished signs that illustrate these goals.

## Conceptualizing the WERS Food Forest

In order to visualize an established food forest before planting even begins, one needs to have a good understanding not only of how species interact with their environments, but particularly of the site's existing conditions (Fig. 2). The Ursinus food forest will be established on two acres at WERS, an 11-acre parcel of land with a history of traditional agriculture. The entirety of the Trappe/ Collegeville area had close to a hundred-years of rainfed agriculture before post-WWII suburbanization began to slowly replace agricultural fields with residential subdivisions. The sole remaining farmstead in Trappe, Northern Star Farm, was placed under agricultural easement starting in 1992 ("About Northern Star," n.d.). Agriculturally eased farms greater than 100 acres in size are allowed to subdivide their land into smaller farmers that remain economically viable (MCPC, 2014). In Spring 2013, Northern Star Farm subdivided and sold a section of this land to Ursinus to create WERS. The Environmental Studies and Biology departments were able to make the purchase with a generous donation from Ursinus alumni Donald Whittaker, Andrew Whittaker, and Elizabeth Magrann. The three siblings donated funds to name the site in honor of their parents. Both departments intend to maintain the site's agricultural legacy by growing food for local consumption.

The food forest will be planted along the existing riparian buffer that borders the southeast edge of the WERS site (Fig. 1). In its current state, the site consists of an open field of forage crops with a narrow forest edge that experiences greater sunlight availability further from the tree line. The agricultural history effectively places the site in an early successional stage with some soil disturbance and erosion. In addition to the moisture of the adjoining stream, standing water regularly accumulates along the northeast fence line. Annual precipitation across the entire state of PA averages around 1,053 mm of rainfall. The entire site overlays a soil of Penn silt loam (USDA, n.d.).

**Figure 1.** The food forest, represented by the range of green and yellow canopy layers, occupies the southeast edge of the Whittaker Environmental Research Station, represented by the green outline, in Trappe, PA.

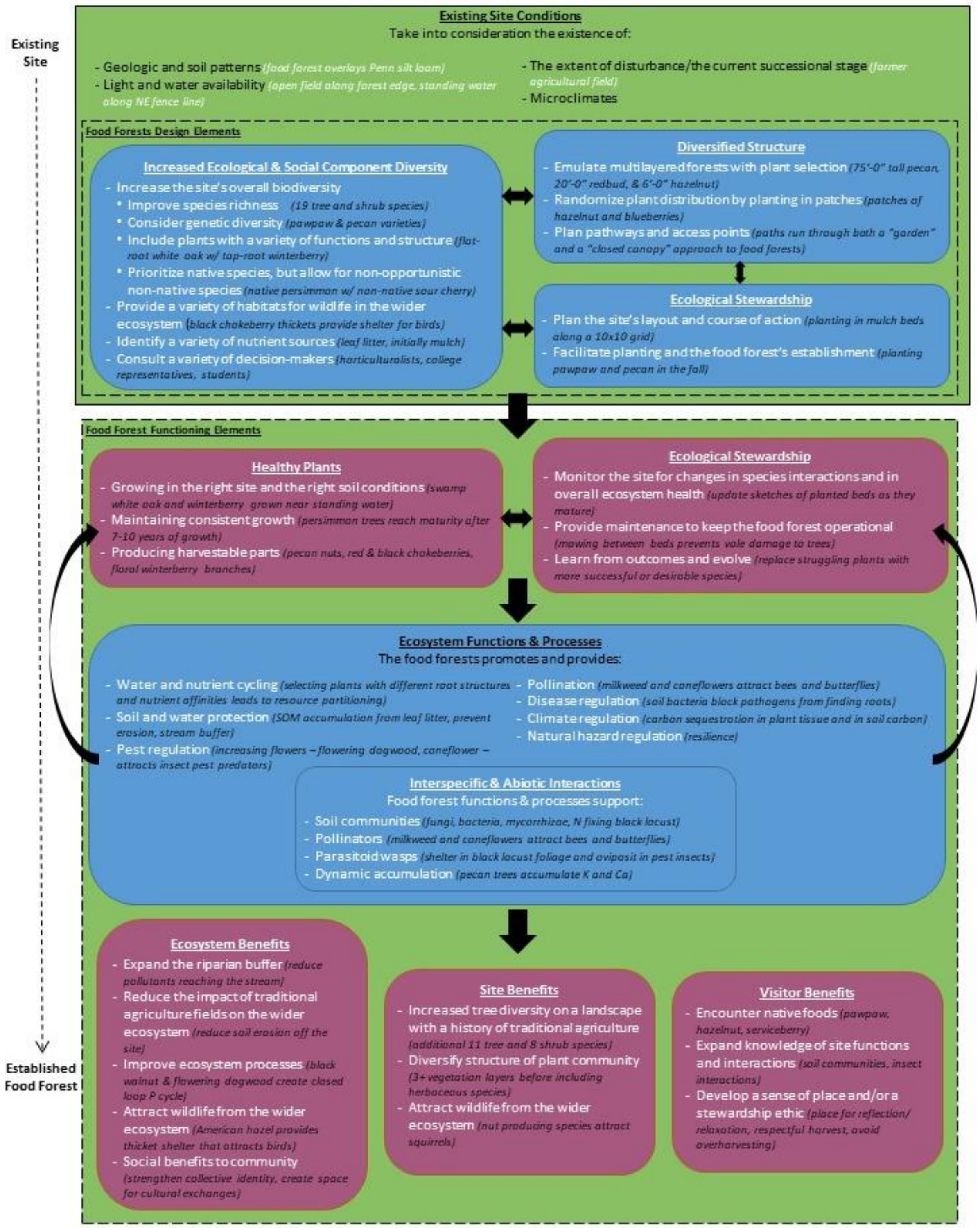


**Figure 2.** The conceptual diagram of the WERS food forest illustrates the interplay of influential factors and processes that shape the system's benefits as the food forest matures. Some of these factors influence each other within the same temporal or physical space (double arrows) while others represent complex feedback loops that manifest themselves across these scales (curved arrows). Examples of the wider concepts as they pertain specifically to WERS are included in parentheses. Adapted from Jacke & Tosenmeier, 2005.

The food forest design takes the extent of these existing conditions into consideration to then superimposes agroecological design elements onto the site through a series of plantings and small-scale land modifications. At the core of the food forest's design is an increase in the site's plant diversity, which is intended to support increases in both ecological and social complexity. The overall increase in biodiversity, assessed across a variety of metrics, is one of the clearest examples of this plant diversity (Matlock & Morgan, 2011b). Planting 19 tree and shrub species improves the species richness of WERS, while the inclusion of four pawpaw (*Asimina triloba*) varieties and three varieties of pecan (*Carya illinoinensis*) addresses genetic diversity. Biodiversity is underpinned by the structural and functional features of the plants themselves, such as interspersing tap-root winterberries (*Ilex verticillata*) around flat-root swamp white oaks (*Quercus bicolor*). There is some debate within the environmental community over whether or not non-native species should be included in designed ecosystems as a means of increasing diversity and addressing environmental problems. Instead of rejecting non-native species outright at WERS, the food forest prioritizes the inclusion of native species to fulfill specific niches, but still includes non-opportunist non-native species (Jacke & Toensmeier, 2005; Hallett et al., 2013) that can provide appealing foods for the local community and contribute other ecosystem benefits. This principle led to the decision-making process that selected the native Americana persimmon (*Diospyros virginiana*) over the non-native kaki persimmon (*Diospyros kaki*), while still including the non-native sour cherry (*Prunus cerasus*).

The design improves site diversity far beyond the selection of individual plants to increase biodiversity. If chosen correctly, the inclusion of certain species or species combinations can grow to provide wildlife from the wider ecosystem with a variety of habitats. Some of the shrub species planted in the food forest, such as black chokeberry (*Aronia melanocarpa*) and American hazel (*Corylus americana*), form thickets that provide shelter for birds. Diversity also plays a role in determining the source of inorganic inputs, such as nutrients. While leaf litter and other organic material from the food forest will eventually become the main source of nutrients when they decompose and reenter the soil for uptake, the gradual decomposition of mulch from the planting beds will serve as that nutrient source until the food forest establishes itself. All of these aforementioned components improve ecological diversity, but it is equally important that social diversity be taken into account during the design process (Folke et al., 2009; Yung et al., 2013). A variety of decision makers, including horticulturalists, college representatives, and eventual student input, were consulted during and after the planning stages for the WERS food forest.

Food forests distinguish themselves from other food producing landscapes by incorporating some of the diverse structural elements that characterize healthy forest ecosystems (Bukowski & Munsell, 2018). The presence of multiple vegetation layers is often one of these features (Fig. 3). The WERS food forest incorporates multiple layers with pecans as the tallest canopy level at 75 feet, under which a shorter tree layer manifests itself in the 20-foot-tall Eastern redbuds (*Cercis canadensis*), followed by a shrub layer in the form of 6-foot hazelnut bushes. Another forest ecosystem feature that is less apparent to some is the replication of forest dispersal patterns achieved by planting different species in patches. Successful reproduction in forest ecosystems results in overlapping species clusters of different densities (i.e. clumps, drifts, and scatters) that create a complex polyculture (Jacke & Toensmeier, 2005). Hazelnuts, highbush (*Vaccinium* *corymbosum*) and lowbush blueberries (*Vaccinium angustifolium*) are planted in drifts throughout the food forest to emulate shrub distributions. The inclusion of pathways and access points through the plantings and species clusters diversifies the system's structure, but does so by influencing visitor's experiences more so than it influences the system's functioning. Well-planned paths provide visitors with the ability to view both the "garden" and "closed canopy" models of food forestry that have been designed into the site's northern and southern edges.

**Figure 3.** Multiple vegetation layers are designed into the restored sections of Point State Park in Pittsburg, PA, along easily accessbile pathways. Photos: Patrick Hurley, 2018.

Ecological stewardship branches the gap between the theory of replicating a forest ecosystem with the design elements described above, and the implementation of the project. Much of the stewardship is reflected in the species selections and design decisions that were made to integrate certain forest features into the 10x10 grid of mulch beds. This careful planning process led to the integration of two food forest models (one focused on rural landowners, the other on suburban owners) designed to show visitors that food forests can exist at a variety of scales. Undertaking the planting and the food forest's establishment is the first step in creating the physical site. The WERS food forest will be taking this first step by planting pawpaws and pecans in the fall of 2019. It should be noted that these design elements – increased ecological and social component diversity, diversified structure, and ecological stewardship – must interplay with one another to generate an ideal design upon which the site's subsequent maturation and development depends.

Once planted, the food forest transitions from the design phase to the site's maturation and functioning. The early stages of development are highly reliant on plant health underpinned by regular and ongoing ecological stewardship, since without healthy plants the rest of the system fails to operate at its maximum capacity. Planning that ensures the plants are growing in the right site and in the right soil conditions before they are even planted is the first part of supporting this healthy growth. This is accomplished at WERS by planting water tolerant white oak and winterberry in the northeastern edge where standing water accumulates. Stewards can assess the effectiveness of their planning by determining whether the plants are maintaining the consistent growth necessary to reach maturity and start producing fruit (e.g. two to three years for blueberry bushes, seven to ten years for persimmon trees, and 14 to 17 years for pecan trees) and whether they are producing harvestable parts (e.g. pecan nuts, blueberry fruits, floral winterberry branches).

Ecological stewardship is not restricted to the planning and implementation stage, as described above. It also encompasses all the maintenance activities that keep plants healthy and readjust conditions if plant health starts to fail. Constantly monitoring the site for changes in ecosystem health can be done by taking notes on a regular basis of plant conditions (e.g., discoloration of leaves, dead branches, injuries to bark). Regular activities, like mowing between planted beds to prevent vole damage to trees, is one means of protecting the trees and of ensuring the food forest remains operational. Weeding and supplemental mulching bolster plant growth by retaining soil moisture and reducing competition for resources. If, by contrast, the plants are not faring well, site stewards can learn from what is prospering in the given conditions to evolve the plan and layout by replacing struggling plants with species that are more successful or desirable.

The combination of healthy plants and ecological stewardship in turn fosters the ecosystem processes that influence the system's interspecific and abiotic interactions (Matlock & Morgan, 2011a). By selecting and nurturing structurally and functionally diverse species, the food forest sustains water and nutrient cycling (Fig. 4). This is especially the case when root structures lead to resource partitioning of the water source or when certain species are more attuned to accumulating certain nutrients over others (e.g. pecan accumulates potassium and calcium). Food forests are also effective at creating and protecting soil resources. In conjunction with soil communities of fungi, bacteria, mycorrhizae, and nitrogen fixing plants like black locust (*Robinia pseudoacacia*), the food forest is able to transform leaf litter and other organic detritus into the soil organic matter (SOM) that feeds the rest of the system.

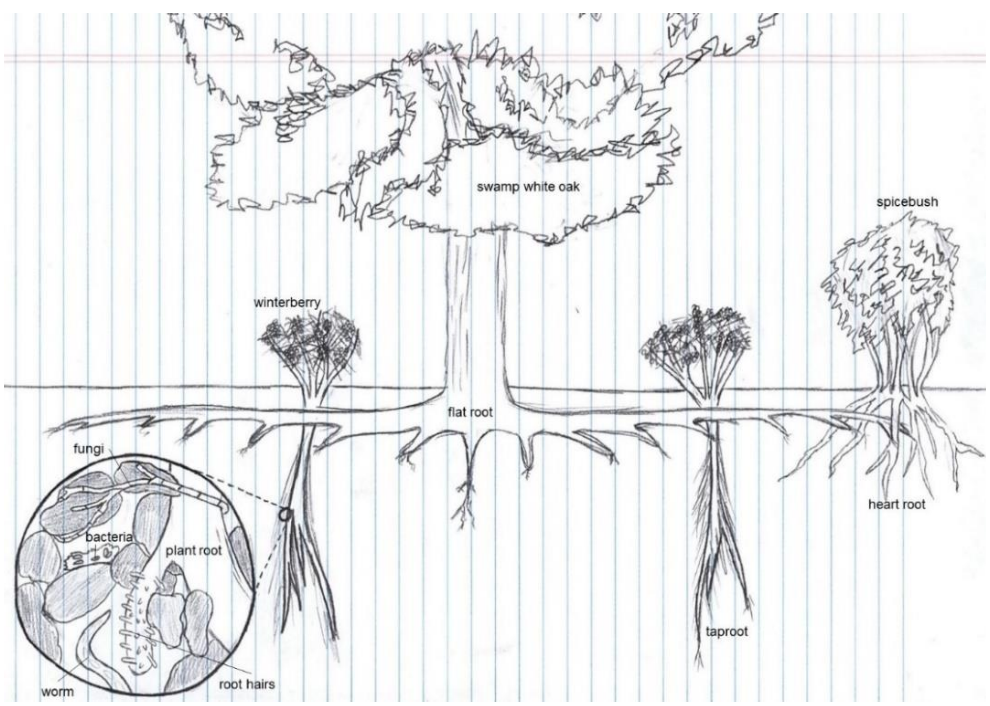


**Figure 4.** The combination of plants with diverse root structures leads to resource partitioning of water and nutrients.

The inclusion of plant species that attract other living creatures are also central to some of these processes. The inclusion of flowering perennial non-woody species, such as milkweed (*Asclepia syriaca*) and coneflowers (*Echinacea* spp.), are particularly influential as they attract pollinator insects such as bees, butterflies, and wasps that are responsible for the sexual reproduction of species in the food forest. Parasitoid wasps often number amongst these pollinators, but serve the dual purpose of pest regulation by laying their eggs in insects that damage plant growth. Black locust foliage is particularly effective at providing these wasps with shelter. The creation of healthy root systems attracts their own set of beneficial organisms. The attraction of beneficial soil bacteria that rely on root exudates to these root systems protects these species from disease since the bacteria can block pathogens chemically and physically from finding or reaching the roots (Jacke & Toensmeier, 2005).

The food forest's ecosystem processes also extend beyond the physical boundaries of the planting site. Tree growth in these food producing ecosystems have the potential to store significant amounts of atmospheric carbon through carbon sequestration, both as plant tissue and as soil carbon. This sequestration has the potential to impact climate regulation at the site, but these claims would benefit from more extensive inquiry and substantiation. Regardless of the impact food forests have on carbon sequestration, climate change will expose these same systems to more extreme conditions. The ability of food forests to adapt to these adverse conditions while maintaining their functionality relies largely on the increased biodiversity of the site, as it provides the system with alternatives if a single part succumbs to stressors (Folke et al., 2009; Naylor, 2009). All of these functions exist in a feedback loop with plant health and stewardship, since healthy plants foster the functions that later support them (Fig. 2).

As the system matures into an established food forest the benefits start to emerge from the above interactions at three scales: ecosystem wide benefits, on-site benefits, and on-site visitor benefits. The wider ecosystem that surrounds the field benefits largely from the expansion of the existing buffer from its current 50 feet to a minimum of 100 feet at the narrowest point, with many points going beyond that width. This expanded buffer is intended to reduce the impact of traditional agriculture on the stream and the rest of the ecosystem, largely by reducing soil erosion off the site and into the stream. The streamside ecosystem can also expect a decrease in nutrient pollution as the inclusion of species like black walnut (*Juglans nigra*) and flowering dogwood (*Cornus florida*) capture phosphorus and other nutrients in a closed loop, thereby reducing nutrient leaching from the soil. The habitat and food resources derived from plant combinations in the food forest bolsters wildlife populations—ranging from insects to small mammals—from the wider ecosystem. Spicebush (*Lindera benzoin*) provides birds with fall fruit while red chokeberry (*Aronia arbutifolia*) provides them with winter fruit, thereby offering a food source throughout the year.

The site itself incurs the same benefits as those of the wider ecosystem due to the increase in species diversity on a landscape with a history of traditional agriculture. This increased diversity manifests itself in the addition of 11 tree, eight shrub species, and numerous to-be-determined non-woody perennials, and the more than three vegetation layers created by these species design. This plant diversity is expected to translate into an increase in insect and animal diversity, as the availability of food and shelter attracts beneficial wildlife species from the wider ecosystem. The presence of nut-producing species is expected to attract squirrels, while planting black locust provides shelter and egg laying site for parasitoid wasps and lacewings, respectively, both of which contribute to pest control.

Individual human visitors to the site largely benefit in an educational capacity. Experientially, visitors have the opportunity to expand their horizons by encountering relatively unknown native foods, such as the pawpaw, hazelnuts, and serviceberries (*Amelanchier* spp.). The inclusion of interpretive signage improves the learning capacity of unguided experiences by providing visitors with access to information on topics about which they may be unfamiliar, including invisible soil communities and insect interactions. Ideally, these efforts will aide individuals in developing a sense of place in the food forest. Besides an intellectual connection, fostering such an emotional connection could be nurtured by providing opportunities for relaxation and reflection within a site that is already rife with sensory stimulus to heighten the experience. Stewardship will likely center around the concept of visitors engaging in a respectful and reciprocal harvest, though it would be beneficial to develop messages that are applicable both within the food forest and in individuals' daily lives (Kimmerer, 2015). Beyond what individual visitors gain from the site, the larger community also incurs some social benefits which includes a space within which members can meet for cultural exchanges that strengthen their collective identity (Bukowski & Munsell, 2018). The potential to develop an economic market around some of these plants, such as the pawpaw, should also be considered.

## Developing an Interpretive Message

A well developed, unifying message is integral when creating interpretive signs that focus on a subject as wide-ranging as food forests. This central interpretive message guides the selection and presentation of each sign's topic. Developing this message, however, begins with an assessment of the intended audience. Existing interpretive signage is primarily critiqued as being designed to appeal to site managers, rather than to the visitors coming to these sites and for whom the signage is intended (Ballantyne & Hughes, 2003). Avoiding this pitfall begins by assessing the interest and knowledge level of the food forest's intended visitors. It should be noted that this profile of potential visitors is based on studies of visitors at non-food producing, natural sites. It does not constitute a thorough assessment of either the Ursinus student body or the Trappe/Collegeville community's environmental knowledge.

Research shows that visitor interest in conservation issues remains relatively low when those visitors intend to use spaces, like botanical gardens, for relaxation or recreation (Ballantyne et al., 2008). Although there are numerous features, including intended uses, that distinguish food forests and botanic gardens, it should be recognized that food forests could ostensibly be used for socialization purposes. The remainder of this intended audience profile relies on the assumption that, in addition to those individuals who use the site to socialize, the majority of visitors possess some interest in learning about food systems and ecological issues. These people range in age from elementary school students, to college students and community residents. The variability in both age and educational background lends itself to inherent differences in visitor knowledge and reading ability. Food forests similar to the WERS model operate under the understanding that while visitors vary in their prior knowledge of food producing landscapes, they are unified by their environmental concerns and social desires (Bukowski & Munsell, 2018).

From this visitor profile we can then set learning objectives. The unique combination of food producing species with forest ecosystem characteristics sets the WERS site apart from other naturalized or reclaimed sites. Therefore, making visitors aware of the site's multifunctionality should be a primary objective of any signage along the paths. Effective environmental education, however, cannot focus solely on ecological concepts, such as multifunctionality, without placing equal emphasis on the development of environmental values (Ballantyne & Packer, 1996; Ballantyne, 1998). In addition to educating visitors about processes like nutrient cycling that shape the site, the literature clearly indicates signage should instill or develop a greater environmental consciousness in visitors. This consciousness should strive to encourage behavioral changes both on the site and in individuals' daily activities. Effective environmental learning that achieves both goals involves a certain degree of immersion to develop those necessary emotional connections with the site (Ballantyne et al., 2011). Immersion at the food forest should take the form of seasonal multisensory and interactive experiences for visitors. While harvest activities occur in the summer and fall, the spring hosts a variety of blossoms that engage visitors' vision and sense of smell, and the winter provides visitors with opportunities to watch non-migratory wildlife. However, the inclusion of such experiences necessitates additional management goals to promote visitor safety (Cambardella, 2013). Signage about harvesting and eating plant parts must address that messages about which species and/or which plant parts are safe to consume (and which are not) are easily read and understood.

The tension in developing a theme that meets these objectives comes then from finding a balance between the utilitarian and intrinsic value perspectives through which the site can be viewed. The utilitarian perspective views the food forest as a means of directly benefiting humans alone, while the intrinsic value perspective hold that nature is worth protecting irrespective of its benefit to humans or lack thereof. The theme "Humans can work with nature to create landscapes that benefit both us and the more than human world" attempts to straddle these two perspectives, while also recognizing that this specific ecosystem would not exist without human intervention. Importantly, this theme also recognizes that human intervention does not occur outside the context of natural processes and influences. The subtleties of this theme will guide both the selection of subjects and materials for interpretation, and the development of each sign's content once topics are selected.

Three main subthemes branch out from this central point. The first is that the food forest is a designed ecosystem that requires some human input and maintenance in the form of stewardship. However, this stewardship must be understood in the context of the rules set by natural influences and within which those decisions can occur. The second maintains that food forest derived benefits are valuable to humans and non-humans alike, whether these benefits manifest within or beyond the fence line. The third subtheme states that food forest visitors must care for and respect all elements of the ecosystem to ensure that it is able to continuously support itself and the community in the future.

## Mapping Ideal Signage Types and Locations

A careful review of the interpretive signage literature reveals that there are five main types of information that should be integrated into the signage for this site:

- Orientation & Directions: Provides visitors with a visualization of the site and a means of locating desired features within the food forest.
- Identification: Labels species throughout the food forest with pertinent information. May have some overlap with the content included in Warning & Safety information.
- Warning & Safety: Informs visitors about potential hazards to their health and safety during their visit, and what actions they can take to avoid those risks. These concerns are largely related to what species and plant parts are edible versus which should be avoided.
- Interpretation: Provides visitors with information about the site and its noteworthy features in a fashion that aims to educate and inspire, as opposed to simply listing facts.
- Behavioral: Introduces visitors to concerns about proper ecosystem care by encouraging positive behaviors that respect other visitors, wildlife, the site, and the wider ecosystem.

Signs often incorporates two or more of these types of information into their content. Three such informational groupings deserve extrapolation: entrance kiosks, interpretive signs, and identification markers. The signs installed on entrance kiosks provide visitors with directions, safety warnings, and behavioral information. Interpretive signs, which are installed at noteworthy features throughout the site, contain both interpretation and behavioral information. Identification markers predominantly provide visitors with identifying information, but also include species specific warnings and safety information.

*Entrance Kiosk*

A kiosk should be placed at the main entrance of the food forest to welcome visitors to the site and to provide them with the essential information to appreciate and understand the site (Fig. 5). The most common usage of kiosks at outdoor sites and exhibits is to help visitors orient themselves with a clear map of the site, labeled with its important features (Huggins, 2018; Moscardo et al., 2007; Cambardella, 2013). Noteworthy features at the WERS food forest include a wide range of harvestable species, trails, the outdoor classroom, and the different food forest models. These illustrative models (e.g., suburban backyard, rural stream buffer) were designed into the site to demonstrate that food forests can manifest in any number of ways according to the space restraints and the landowner's needs. The section closest to the northwest entrance emulates the kind of system that can be planted in a domestic garden, while the section closest to the existing riparian buffer demonstrates a closed canopy approach. The strip along the northeast fence line provides an example of a floral based model.


**Figure 5.** This informational kiosk sits at the entrance to the Natural Lands Bryn Coed preserve in Chester Springs, PA. It provides visitors with an overview of the preserve and its trails, the wider context of the ecosystem within which the preserve is located, and brochures with trail maps. The bulletin board is easily updated. Photos: Dan Barringer.

Visitors tend to pay more attention to signage during the beginning of their visit, regardless of the exhibit's topic or size, so it is vital to include the most important messages closest to the entrance (Moscardo et al., 2007). At the outset, visitors to WERS need a clear introduction to the concept of a food forest before they can begin to understand the intricacies presented on subsequent signs. An introductory sign should provide a food forest definition, coupled with a conceptualization of where the site falls in relation to other examples of both food producing ecosystems as well as how these forests differ from more common types of forest ecosystems. Food forests should be placed in the middle of a continuum that ranges from a monoculture annual crop field system to a forested ecosystem undisturbed by human activity, each accompanied by their own definition. If space allows, consider including highly managed orchard systems, agroforestry, planting food producing species into an existing forest, and foraging in forest ecosystems into the continuum of food-oriented modifications to natural forests or woodlands. This range of systems should highlight the benefits obtained from creating this site while also highlighting which elements remain unique to the other systems, especially as it relates to the central theme.

The kiosk should also include a warning and safety sign that identifies which plant parts are edible and the months during which they are ripe. A fruiting calendar listing the common name and harvestable plant part is one potential method (Fig. 6). This display must be accompanied by a statement that clearly tells visitors not to consume any plants not clearly identified and labeled as safe to eat, especially without the expertise of a horticulturalist or botanist. There should be a notice that the food forest grows tree nuts for individuals with severe allergies for whom airborne contamination could be dangerous (Cambardella, 2013). Care must be administered when presenting this information, since visitor interactions that rely on the authority of the agency tend to be perceived as either threatening or condescending (Wallace, 1990). For example, signs that list prohibited actions may leave many visitors feeling indignant and resentful. By contrast, visitors are more likely to heed directions that employ the authority of the resource by respecting the visitors' intelligence, and indicating that specific measures are put in place to protect the ecosystem and not just to address the organization's liability.

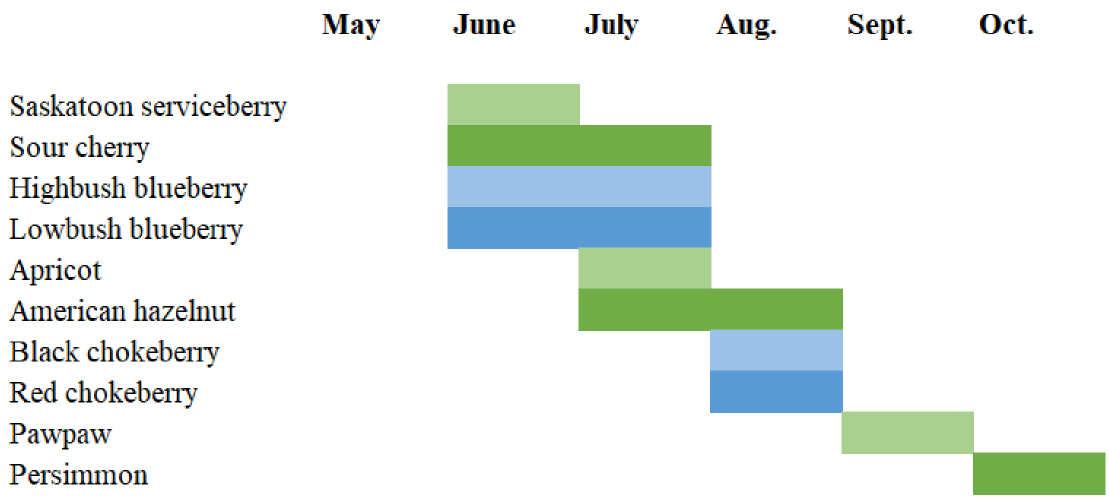


**Figure 6.** Incomplete fruiting calendar for some of the species in phase one of the food forest. Fruiting dates obtained from the Philadelphia Orchard Project (POP).

While the signs above address two of the three subthemes, a final sign at the kiosk should address visitor respect for the site in general and for other people by encouraging positive behaviors. Overharvesting is one of the most tangible concerns worth addressing at the outset of anyone's visit to the WERS food forest. However, research suggests that some incoming visitors already possess a senses of stewardship for the land and its species. Research on foraging in city parks reveals that recurrent foragers engage in stewardship practices that ensure the longevity of the resources they harvest, tend to sites and their species, and enhance the ecosystem (McLain et al., 2017). Signage should recognize that some individuals possess these innate values and commitments, without relying on them to influence behavior. The sign's message of responsible harvesting should engage the authority of the resource – a strategy that uses a shared interest in nature's requirements as the catalyst for changing behaviors – to engage the visitor's own interest in valuing the site (Wallace, 1990). Instead of dissuading overharvesting through negative or proscriptive messaging, the sign should present a positive message about leaving enough behind for the wildlife and other visitors who use the site. It is intended to feel like a thoughtful reminder rather than as an imposition on visitors.

When phase two of the food forest is completed it may be worth installing a replicate of this first kiosk at that southwest entrance off of College Ave. This instance is the only case where duplicates of individual signs could be useful in such a small site.


**Figure 7.** "Others eat here too!" models the type of signage that should be installed as part of the entrance kiosk. This sign is specifically designed to employ the authority of the resource when providing behavioral suggestions. The colors and typeface selections maintain the college's brand identity. Important takeaway messages are presented in larger font size for emphasis. Illustrations provide specific examples of other animals eating foods that humans can eat, thereby reinforcing that the food forest community consists of both the human and non-human.

*Interpretive Signs*

To avoid overcrowding the site with interpretive signage and distracting visitors, we will follow the general rule that a ¼ mile long trail supports around 10 signs (Moscardo et al., 2007). The trail that is currently planned to run through phase one of the food forest, which measures around 1/10$^{th}$ of a mile, can thus support around four interpretive signs. The expansion of the path system into phase two of the project will lead to more space for signage. Wherever possible, signs should be located at forks in the path or areas where the path widened, since these natural stopping points are areas where visitors are already inclined to slow down (Davis & Thompson, 2011; Moscardo et al., 2007). Placing signage in these locations also controls the movement and flow of people through the site to avoid bottlenecks and overcrowding. Since signs will be placed in close proximity to the plants they are describing, efforts should be made to ensure that permanent signs are installed far enough away from mature foliage, so that intervening growth does not disrupt visibility (Fig. 8). For instance, since mature American hazel shrubs grow to a diameter of six feet, signs should be placed a minimum of three feet, if not more, from their bases.

**Figure 8.** Growth obscuring signage in the pollinator garden at the Fairmount Park Horticulture Center in Philadelphia, PA. Photo: Patrick Hurley, 2019.

An analysis of the conceptual elements included in phase one reveals four overarching topics:

A. <u>Soil Communities:</u> This sign should present the overarching message that when plants are grown in the right conditions for those species, they become part of a larger community that supports plant growth and life both above *and* below ground (Fig. 9). It should be placed along the northeast edge of the food forest, since the swamp white oak and winterberry root systems best exemplify the structural diversity that lends itself to resource partitioning (Fig. 10). This sign should focus on how this structural diversity leads to the establishment of healthy plants, which helps improve soil quality and fosters soil communities of fungi, bacteria, and other soil organisms. These qualities in turn improve nutrient cycling, disease regulation, and soil carbon sequestration within the system. If space permits, it may be appropriate to reference the frequency with which this section of the site accumulates rainwater, thus necessitating the selection of riparian species. Promoting environmental consciousness in the reader can take the form of connecting actions from their everyday lives to soil systems like this one. It should incite discussion about how their lawns and gardens might compare.

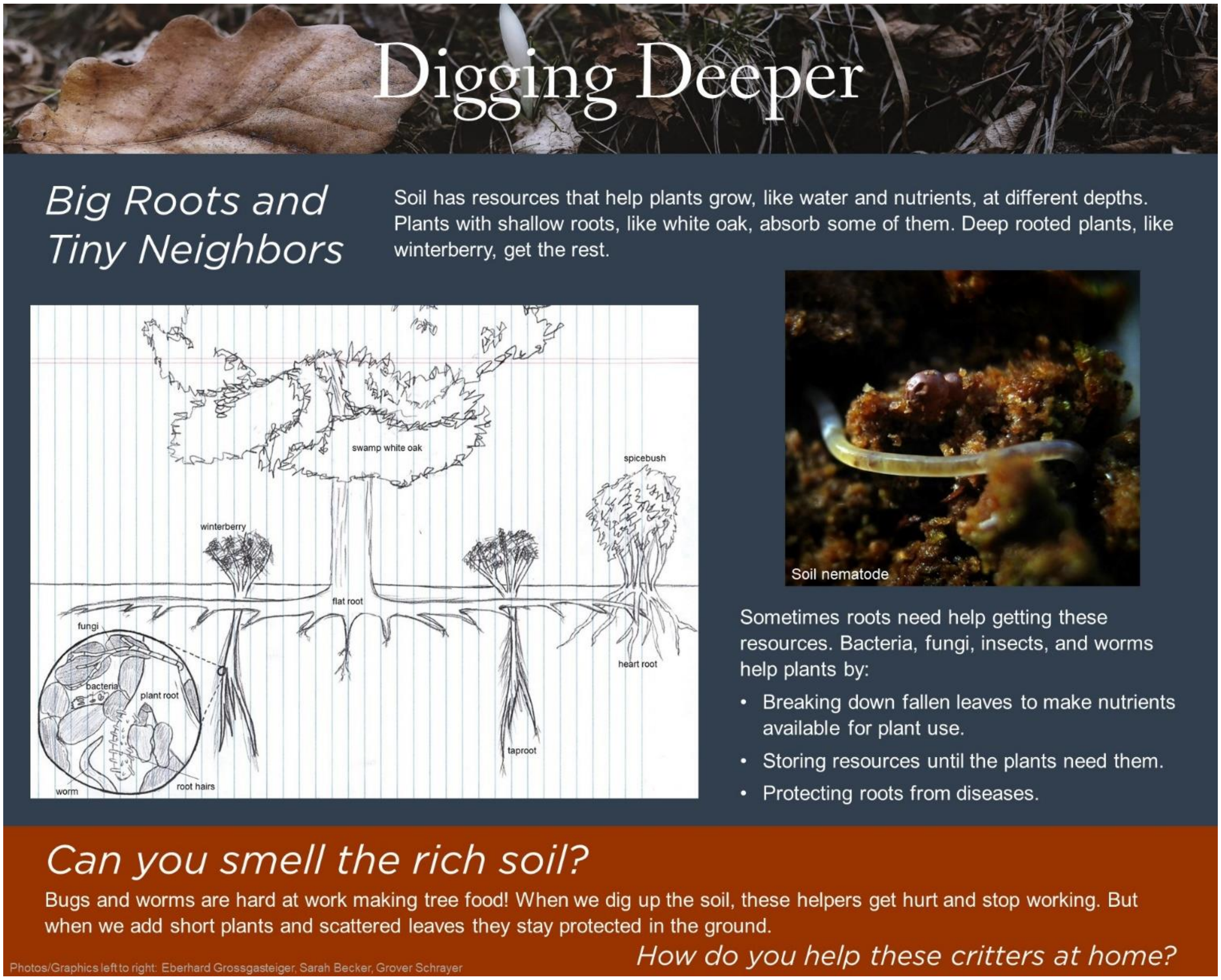


**Figure 9.** "Digging Deeper" models an interpretive sign with a focus on soil communities. The sign covers the specific topics of resource partitioning and beneficial soil community interactions, and includes suggestions for how visitors can improve soil communities where they live. The navy-blue background is intended to complement the food forest atmosphere. The brown accent color unifies the other visual components (e.g. title banner, soil nematode). The soil profile diagram, while not a photograph, is valuable because it provides visitors with a novel perspective.

B. Wildlife Habitat: This sign should communicate the message that increasing a site's plant biodiversity attracts wildlife that help to further enrich the site. This sign should be placed in close proximity to the black locust and American hazel, two species that attract a variety of birds and insects, in the center of the site (Fig. 10). This sign should explain how increasing the species richness and habitat diversity of an agricultural field that grew a limited number of herbaceous species can improve what food and shelter is available to wildlife in the surrounding ecosystem. The American hazel, for instance, provides birds with habitat and squirrels with food. The sign should also explain that these creatures improve the health of the rest of the site, since the insects that find habitat in black locust leaves engage in pollination and pest regulation (parasitoid wasps). Pollination initiates the reproductive cycle for many of the harvestable propagules, while pest regulation ensures that the majority of these fruits and nuts reach maturity. Providing examples of how to increase wildlife habitat in the reader's backyard is one means of encouraging visitors to care about this topic.

C. <u>The American Hazelnut:</u> This sign should be centered around the message that the foods we commonly encounter in supermarkets have fascinating ecological and ethnobotanical contexts, highlighting both human and nonhuman-oriented benefits. The sign should be placed with the cluster of three hazelnut shrubs in the northwest section of the site, since it evenly spaces the interpretive signs from each other (Fig. 10). The content should focus entirely on the defining characteristics of this species, with a particular emphasis on the plant's ethnobotanical history. For example, Iroquois peoples collected hazelnuts, amongst other nuts, and ate them by cracking them open with round stones that had well-worn recess in the center (Waugh, 1916). In addition to being eaten raw, hazelnuts also were incorporated into breads, gravy, potatoes, hominy, and soups. Likewise, although it is already covered in the "Wildlife Habitat' sign, there could be a brief reference to the habitat benefits this shrub provides. If space permits, the text should use the patch structure as an example of how the site's layout is influenced by forest ecosystem characteristics, in this case plant distribution patterns. Fostering care in the reader could take the form of asking them to think more in-depth about the histories of the foods that they eat.

D. <u>Site Context:</u> This sign should be designed around the message that the food forest project is a restoration effort that integrates both the historically forested nature of the region with the agricultural legacy of this specific site. It should be located in close proximity to the stream, just south of where ramps will be planted in the future, so that visitors congregating around the sign neither block flow out of the classroom nor trample the ramps (Fig. 10). This sign should explain the agricultural and then suburban transformations the Trappe/Collegeville area are undergoing, both of which replaced the woods that covered 90% of the east coast. It should also reference the food forest's usefulness as a restoration tool, especially in its role as a riparian buffer that actively improves the water quality of the unnamed tributary it borders. Headwaters are vitally important for protecting downstream habitats. This sign can inspire visitors to think more critically about the consequences of their behaviors by asking them how they impact their "downstream" neighbors.

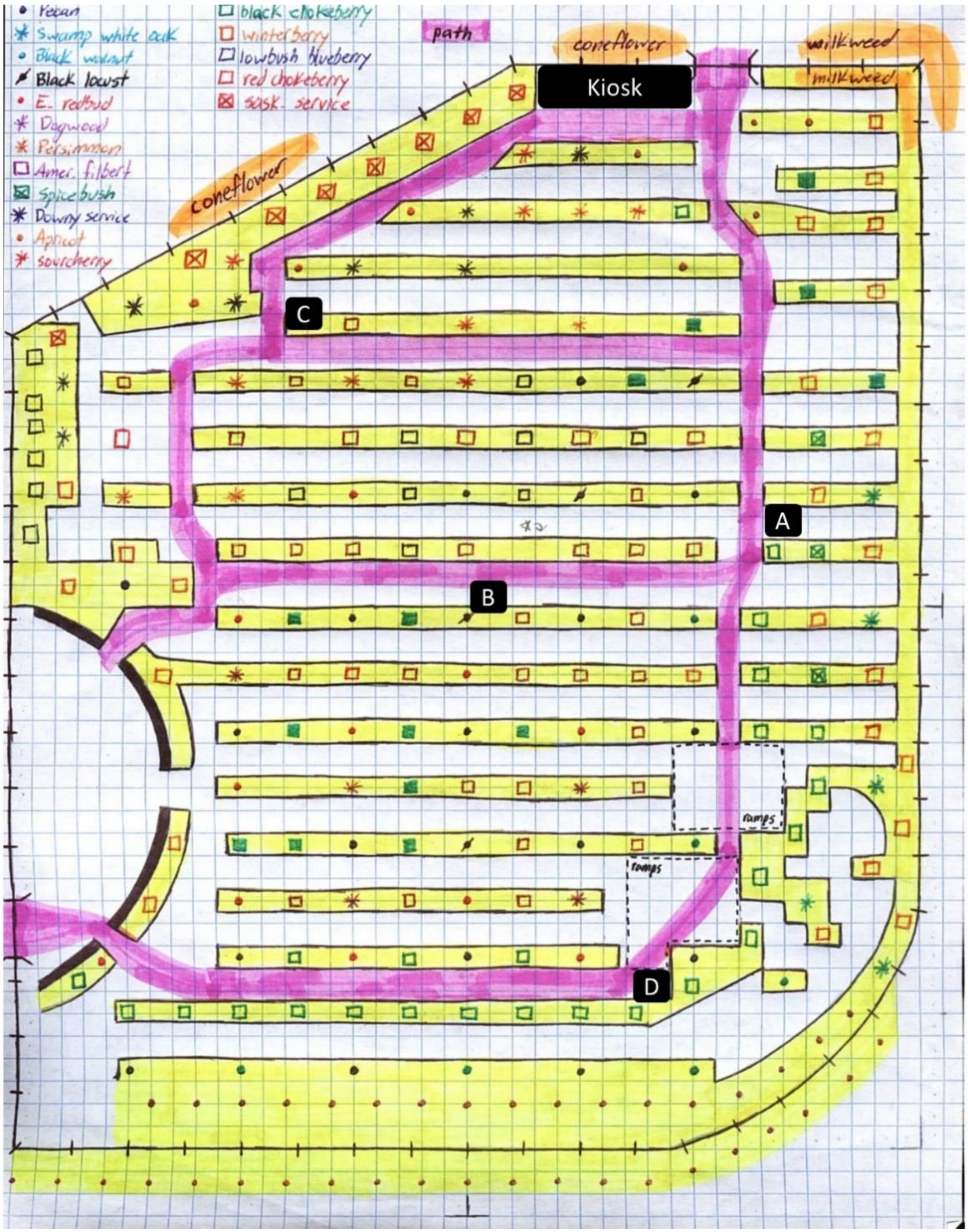


**Figure 10.** Suggested placement of interpretive signs within phase one of the food forest. Signage topics include A) soil communities, B) wildlife habitat, C) the American hazelnut, and D) site context. Kiosk signage should include a map of the site, the food forest continuum, a notice about safely harvested plant parts, and the encouragement of respectful harvesting practices.

*Identification Markers*

Every standalone species should be labeled with an identification marker that provides visitors with the common and scientific names, a picture of the plant, and any health or safety concerns (Fig. 11). Each of these tags should mention which plant parts are edible, which parts to avoid (e.g. saskatoon serviceberry (*Amelanchier alnifolia*) leaves), and if a food allergy is possible. Allergy information is particularly important for tree nut producing species (e.g. black walnut, pecan, and hazelnut). If a number of the same species of plant are grouped directly together (e.g. pawpaw, black chokeberry, lowbush blueberry) one identification marker can be centrally placed, so long as it clearly identifies the whole group. At most, 241 markers will be necessary to identify every individual tree and shrub planned for phase one of the food forest.


**Figure 11.** Identification marker for red currant (*Rubes rubrum*) found in the Philadelphia Orchard Project (POP) kitchen garden and orchard at the Woodford Manor in Philadelphia, PA. Markers help visitors to identify the species, by including a picture of the plant, and provide details about the species' uses and niche information. Photo: Patrick Hurley, 2019.

## Design Parameters

We note that Ursinus College is currently engaged in a rebranding effort that includes the modification of existing signage on campus. As of the summer of 2019, these efforts are predominantly focused on wayfinding, and do not include plans for interpretive signage. We discuss the college's branding and design dynamics in the next section.

*Textual Elements*

When developing text for any of these signs, the focus should primarily be placed on the qualitative nature of the content. The majority of the specifics in this section relate specifically to the interpretive signs, since they are the most information and synthesis heavy. Nevertheless, the overall messages can be applied to any signage type. The goal of interpretive text is to encourage visitors to view and engage with the surrounding environment more so than they would have done otherwise (Wandersee & Clary, 2007). Visitors are more likely to absorb the meaning of a sign if it can successfully maintain the reader's attention. Increasing the reward within the text to render reading more enjoyable prolongs the amount of time visitors spend at a sign (Moscardo et al., 2007). The best way to make reading enjoyable is by creating a personal connection with the reader that leads them to develop their own relationship with the site. These connections often rely on the use of more personal narratives told with direct, active, and conversational writing. Telling another person's story, linking exhibit features to visitors' daily lives, using cause-and-effect relationships, and employing literary devices like analogies, metaphors, and personification of the non-human are all useful tools for creating that connection.

Another key way to increase visitor engagement with the site and the sign is to design activities and interaction into the content. Most of the immersive exhibits at interpretive sites are imitations of time periods that make use of recorded sounds, introduced smells, and period specific artifacts to create the semblance of a different environment (Moscardo et al., 2007). The fully functional nature of the food forest negates the need for human curated senses since it produces its own sights, smells, sounds, tastes, and textures. Signage text should encourage visitors to experience different senses (e.g. hearing wildlife, smelling soil, looking at and breathing in fragrances from blossoms) as they manifest themselves in the signage topics. Other tactics for encouraging engagement include challenging visitors to search for some feature along the trail.

A major objective of this signage effort is to promote thought in visitors about the environmental implications of their daily practices. When groups visit the site, the ensuing social atmosphere is not conductive to engaging visitors in environmentally conscious thought just by presenting them with relevant environmental information. Efforts to stimulate thought should focus instead on promoting social conversations about these educational topics (Ballantyne et al., 2008; Ballantyne et al., 2011). The incorporation of open-ended questions and examples of how visitors' daily behaviors can both positively and negatively impact the ecosystem are two suggestions for how to initiate these discussions (Ballantyne, 1998; Ballantyne et al., 2011; Davis & Thompson, 2011).

Quantitative writing metrics should only be taken into account during the editing stage and after the conceptual components have been well developed. These metrics are intended to give the reader the impression that the material on each sign is short, legible, and therefore worth the time to read (Wandersee & Clary, 2007; Moscardo et al., 2007). Some metrics from the literature worth considering when writing are to:

- Keep the title short at a maximum of 10 words.

- Limit the number of words per sign to 30-100. A sign with two topics should average around 70 words. Signs covering three topics can have a maximum of 150 words.
- Keep sentences short and concise, with an average sentence length around 42 characters.
- Restrict the presence of passive voice to under 20% of the sign's sentences. This does not mean that passive voice should be eliminated entirely, since when used sparingly the change of pace improves the sign.
- Maintain reading complexity around an 8th grade level. This generally involves using short words and avoiding jargon.

Some of these measures will vary according to the type of sign. For instance, since the identification markers are smaller, with less of a focus on synthesizing a message, they have the potential to contain fewer words. They should still strive for comprehensibility.

*Visual Elements*

The visual component of each sign is equally important when attracting and maintaining visitor attention. Research shows that the modification of a sign's visual elements alone significantly increased the sign's attracting power, holding time, and main message recall among visitors (Jensen, 2006). The visual elements that make reading easier are layout, text type and size, use of color and contrast, and the inclusion of illustrations (Moscardo et al., 2017). Since the food forest effectively houses a set of signs, they should retain enough similar elements to indicate unity (e.g. material, borders, general layout, typeface), while varying other elements (e.g. illustrations, accent colors, specific layout) to retain visitor interest. Designing variability and nuance into these signs avoids too much repetition, and increases the likelihood visitors will continue reading signs as they move through the site (Ballantyne & Hughes, 2003; Moscardo et al., 2007).

<u>Layout:</u>

Organizing text in a hierarchy improves visitors' ability to connect the information sequentially as they read it. This layout effectively builds bridges between bits of information, and strengthens visitor understanding of the topic (Moscardo et al., 2007). A detailed layering of the text uses four levels:

- <u>Level 1:</u> Title and a short introduction.
- <u>Level 2:</u> Subheadings that divide topics from one another. There should be a maximum of two or three topics per sign.
- <u>Level 3:</u> The main body of the text interspersed with key illustrations. This information can be further subdivided into general and specialized knowledge with the intent that visitors can choose to read up to the level of information that appeals to them.
- <u>Level 4:</u> Suggestions of what visitors can do with this information. This subsection can be adapted to appeal to children, much like the "Kid's Spot" of the Natural Lands signage.

Chunking information in this way breaks up the text to makes it appear more conversational, and therefore more appealing to the reader (Moscardo et al., 2007; Davis & Thompson, 2011). Spacing out elements to leave some blank space around each sign component also contributes to this readability. Blank space acts as a resting point for the viewer's eye and avoids overwhelming them. Organizing features along the rule of thirds helps maintain this spacing.

Text Type and Size:

Font size and typeface are highly influential when it comes to text legibility. Path widths through the food forest ensure that readers nearly always will be within zero to four feet of these signs, therefore (Moscardo et al., 2007):

- Titles should be in 96 point Fanwood (a serif typeface).
- Headings should be in 48 point Gotham Book.
- Body text should be in 24 point Helvetica (a sans-serif typeface).
- Illustration captions and labels should be in 18 points Helvetica.

As mentioned above, Ursinus College is engaged in a rebranding of the college identity that includes redesigning and standardizing on-campus signage. All typeface selections for the food forest should come from the options provided in the Ursinus College Visual Identity and Style Guide (n.d.). A sans-serif typeface was selected for the body text because it allows for quicker reading than other font options (Jensen, 2006). Headings, subheadings, and call-outs use slightly more complex typefaces with small end strokes on the letters since these sections should take more time to read. The use of multiple typefaces to differentiate levels of information helps introduce some variety into the designs, which helps retain visitor attention.

Color:

The use of color and contrast influences signage in two ways: by impacting text legibility and by prompting visitors' emotional responses. All signs in outdoors conditions use an inverted color scheme to improve legibility, especially if any of the signs will be in direct sunlight for significant periods of time (Moscardo et al., 2007). Due to the presence of two distinct messages – an exterior message communicated by kiosk signage and an interior message communicated by the interpretive signage – there should be a separate color pallet that corresponds to each. Sings on the entrance kiosk are intended to provide an introduction to the site and reinforce its link to Ursinus College, and thus maintain brand unity with the use of red (RGB: 152/0/46), gold (RGB: 251/176/52), and black (RGB: 0/0/0) color scheme (Fig., 7; Ursinus, n.d.). By contrast, the interpretive signs can draw instead from a secondary color pallet that compliments the school colors while matching the setting and tone of the food forest. Most outdoor signage makes use of cool colors and earthy tones to provide visitors with a more relaxed or reflective feeling (Moscardo et al., 2007). The WERS signs use a dark navy-blue background with white text to maintains good legibility and a calming atmosphere. Each sign should possess a different accent color that is repeated in the illustrations.

Illustrations:

Illustrations, used here to refer to visuals ranging from drawings and photographs to maps and diagrams, are included in signs as a means of supplementing the text and reinforcing its content. Often, illustrations are most effective when they provide the audience with a perspective they could not themselves experience (Moscardo et al., 2007; Davis & Thompson, 2011). For instance, the “Digging Deeper” interpretive sign (Fig. 9), which focuses on underground soil communities, is accompanied by an illustration of the root structures and soil organisms that comprise those communities. While sketches and drawings may be more appropriate for displaying these novel perspectives, vivid and emotive photographs are more impactful on audiences and should be used in all other instances (Jensen, 2006; Dais & Thompson, 2011). Just be cautious not to include too many illustrations since readers can be just as easily overwhelmed by an overabundance of images as they can be by dense blocks of text (Moscardo et al., 2007).

The food forest map at the entrance kiosk will be one of the most detail-oriented illustrations of the site. This map aims to label the major species within the context of the mature food forest’s canopy. The linear layout in which species are planted makes it possible to individually label each of the tree and shrub species much in the same way as Hopewell Furnace labels their apple orchard map (Fig. 12). However, the presence of multiple vegetation layers means that the map also needs to orient visitors vertically within the space. A rendition of the mature canopy could draw influence from the landscaping plans Penn Park Orchard provides of their site (Fig. 13). A final color version of the map should ensure visibility by displaying the highest canopy layers in more transparent colors, while depicting lower vegetation layers in opaque colors.

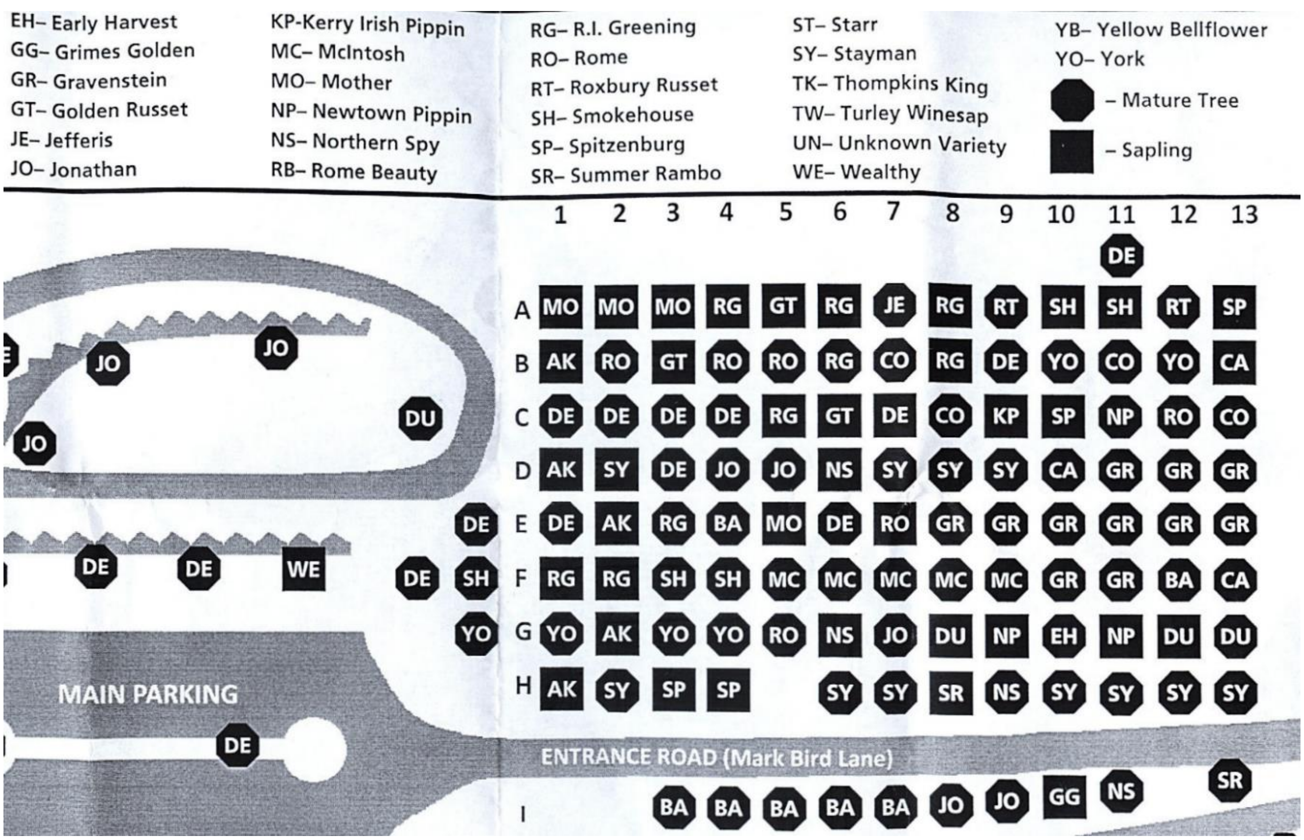


**Figure 12.** Part of the Apple Orchard Variety Map for the Hopewell Furnace National Historic Site in Elverson, PA. The map uses a grid system and abbreviated tree names to orient visitors.

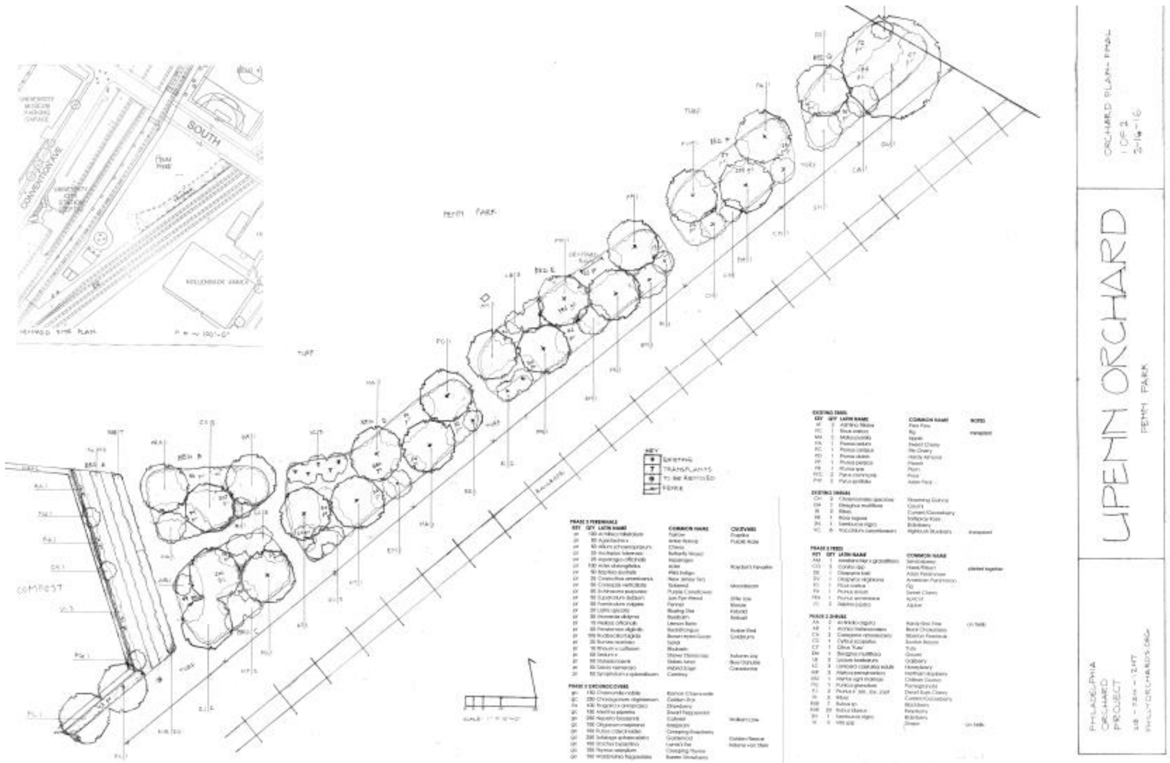


**Figure 13.** The upper orchard plan for the Penn Park Orchard in Philadelphia, PA. The layout makes use of landscaping terminology and symbols.

<u>Interactive Elements:</u>

Interactive elements in signs – such as flip-panels, tactile artifacts, and scaled models – are frequently cited by the literature as effective novel interactions that increase a sign's attracting power and memory recall (Jensen, 2006; Davis & Thompson, 2011; Moscardo et al., 2007). However, given the extensive nature of the multi-sensory experiences the food forest itself produces, it does not seem cost effective to include these elements. Instead, the focus should be placed on including explicit suggestions in the text for visitors to engage in these sensory experiences themselves. The majority of the year, this engagement will take the form of the blossoms and edible fruits the system produces. However, during seasons of plant inactivity the focus can shift to finding and identifying wildlife tracks or other evidence of wildlife activity (e.g. digging, bark damage).

## Cost and Materials

Variations in cost and materials generally increase as the durability and permanence of the signs do. Maintenance costs and upkeep labor after the initial installation also vary according to the material. The options below provide a range of durability and cost options for each of the signage types.

*Entrance Kiosk*

- <u>Fence Mounted Signs:</u> Depending on the type of deer fencing installed at the site, it may be possible to attach light-weight signs directly to the fence at the entrance. Some food forests print banners on a flexible vinyl, which they then tie directly to fences with nylon ropes or zip ties through grommet-reinforced holes (Fig. 14; Bukowski & Munsell, 2018). Banners vary dramatically in price according to the vendor and size. They can be obtained from Banners.com (www.banners.com),Vistaprint (www.vistaprint.com), and Blackhorse Graphics (www.blackhorsegraphics.com) amongst others. **Estimated cost: ~$20.00 to $40.00 per banner.**


**Figure 14.** Fence mounted signs at the Basalt Food Park in Basalt, CO. Photo: Catherine Bukowski, 2018.

- <u>Grid Backboard:</u> Kiosks with grid backboards are built by bolting four 2x4s into notched 4x4 posts, which are then set in the ground. The signs, maps, and any hand-out materials are then directly attached to the horizontal 2x4s. This design allows for flexibility in the layout, since the materials attached to the 2x4s are easily uninstalled, moved, and reinstalled. This is the type of information kiosk that Natural Lands installed at the Bryn Coed preserve (Fig. 5). Lowe's sells 10 foot 4x4s for $13.17 each, and eight foot 2x4s for $4.47 each. Galvanized ½-in x 4-in hex bolts sell for $1.78 each, with the corresponding 13 x ½-in galvanized hex nuts selling for $0.41 each. Kiosk materials should cost around $52.80, assuming it measures four feet in width. Changes in kiosk dimensions will impact lumber prices accordingly. The price of the signs and maps mounted to this kiosk will vary depending on the options listed below. It may be beneficial to make the food forest map semi-permanent and easily updated, since there will undoubtedly be some changes in species composition as the site matures. **Estimated cost: $52.80 frame.**

- <u>Custom Design:</u> Custom designed kiosks are unique and the most effective at maintaining brand identity. However, this design is inflexible in comparison to the grid backboard's ability to change the kiosk's content with relative ease. Such "bespoken" kiosks are installed at Crow's Nest preserve. The Ursinus campus map directories are indicative of what a custom designed kiosk might resemble stylistically (Fig. 15). Manufacturer information can be obtained from Ursinus' Director of Facilities, Steve Gehringer (sgehringer@ursinus.edu). **Estimated cost: Quote based.**


**Figure 15.** Custom designed map kiosks installed at Ursinus College in Collegeville, PA. Photo: Sarah Becker, 2019.

*Interpretive Signs*

- <u>Hand-Made (Semi-Permanent):</u> Semi-permanent signs, made with oil paint sharpies or outdoor acrylic paint on wooden or durable outdoor poster boards, are intended to withstand some external weather conditions (Fig. 16; Bukowski & Munsell, 2018).

Despite the preference for images over sketches and diagrams, these signs are restricted to the use of such drawings. Aside from touching up the paint when it starts to wear, maintenance should be minimal. However, signs will need to be completely remade if they encounter too much damage. A 2 oz. bottle of outdoor acrylic paint costs $1.59, while oil paint sharpies range in price from $3.99 per pen to $18.00 for a set. Outdoor poster boards measuring 28"x44" cost $1.98 each, with bulk discounts when purchasing 25 sheets or more. **Estimated cost: $3.57 to $19.98 for two signs.**


**Figure 16.** Hand-made sign. Photo: Catherine Bukowski, 2018.

- <u>Printed Step Stakes (Semi-Permanent):</u> Step stake signs are printed on corrugated plastic that stand up reasonably well to outdoor forces, though there are some warnings about signs warping in direct sunlight. These signs are not restricted to the use of drawings, but also are able to support printed images. Corrugated plastic requires semi-regular cleaning with a squeegee to ensure any growth or staining does not impair the text's legibility. Unfortunately, most step stakes are relatively low to the ground, thereby making reading difficult when standing. These types of signs are installed in the Fairmount Park Horticulture Center food forest (Fig. 17). Depending on the vendor, good quality signs cost around $14.00 each with discounts for bulk orders. The stakes are sold separately for $3.00 each. **Estimated cost: $17.00 per sign.**


**Figure 17.** Step stake signs installed at the Fairmount Park Horticulture center food forest in Philadelphia, PA. Photo: Patrick Hurley, 2019.

- <u>Aluminum with Vinyl Laminate (Permanent):</u> These outdoor and weather durable signs are made from 2mm thick aluminum panels with matt adhesive vinyl stickers of the design that is applied to the face of the sign. The face is then overlain with a layer of lamination to protect the sticker against fading from UV rays. The finished signs often have rounded corners and drilled holes for mounting. Maintenance is limited to washing the surface when necessary. Signs can be ordered from Jim Veluta (jimv@blackhorsegraphics.com) at Blackhorse Graphics in Media (www.blackhorsegraphics.com). **Estimated cost: Quote based.**
- <u>Custom High Pressure Laminate (CHPL) (Permanent):</u> CHPL signs are advertised as the most durable graphics available with a high resistance to sunlight and UV fading, scratches and physical damage, small burns, graffiti, and other harsh conditions. They can be installed on posts in the ground with an angled pedestal mounting plate. This plate makes the sign accessible to adults and children alike. Maintenance efforts largely consist of washing the sign's surface with soap and water, and applying a sealant to the edges of the panel annually. While the signs are insured for 10 years, the wooden posts on which they are installed may need to be replaced more frequently. These types of signs are installed at Natural Lands preserves, such as at Crow's Nest (Fig. 18). They can be ordered from Fossil Industries (www.fossilgraphics.com). **Estimated cost: Quote based.**


**Figure 18.** Interpretive CHPL sign installed at Crow's Nest preserve. Photo: Patrick Hurley, 2019.

*Identification Markers*

- <u>Hand-Made Labels:</u> Hand-made labels are also made from oil paint sharpies or outdoor acrylic paint on small squares of outdoor poster board, which are hung off of visible branches with nylon cords (Fig. 19; Bukowski & Munsell, 2018). Prices for these labels are the same as those for the hand-made signs: $1.59 for acrylic paint, $3.99 to $18.00 for sharpies, and $1.98 per sheet of poster board. **Estimated cost: $7.53 to $21.96 for 250 markers.**


**Figure 19.** Hand-made labels. Photo: Catherine Bukowski, 2018.

- Plastic Markers: Whole sheets of laminated stickers can be printed with the desired text and pictures, and applied to plastic markers staked into the soil. An additional layer of lamination from a self-adhesive laminating sheet help perverse color and protect against water damage. These markers are installed in Philadelphia Orchard Project (POP) orchards (Fig. 11). A package of 25 blank 1.5" x 3.5" label sheets costs $13.99, a package of full-sized self-adhesive laminating sheets costs $11.79, and a set of 50 angled garden labels sells for $18.99. **Estimated cost: $120.73 for 250 markers.**
- Tree tacks/screws: Metal labels mounted to living trees with springs allow the sign to move as the tree grows and expands, thereby limiting the tag's impact on the tree's growth. The engraved signs have enough space for the common and scientific names. Larger signs include more information. These labels are installed at the Hopewell Furnace apple orchard (Fig. 20). They can be order from sellers like Precision Signs & Labels (www.botanicalsigns.com). The signs start at $5.15 (2"x4"), but increase in size and in thickness. The 3" stainless steel mounting screws and springs are sold at $0.85 each. **Estimated cost: $1,500.00 for 250 signs.**


**Figure 20.** Tree tacks/screws labeling apple trees at Hopewell Furnace. Photo: Patrick Hurley, 2019.

- Engraved Markers: Engraved markers mounted on stakes have space for the common and scientific names of each plant. Some vendors provide space for a couple additional lines of information. These markers are installed at the Penn Park Orchard (Fig. 21). Signs (2"x4") can be ordered from sellers like Plant Signs (www.plantsigns.com) or Precision Signs & Labels (www.botanicalsigns.com). **Estimated cost: $1,655.00 to $1,837.50 for 250 signs.**


**Figure 21.** Engraved markers installed at the Penn Park Orchard. Photo: Patrick Hurley, 2019.

## Next Steps

This protocol attempts to provide a comprehensive plan for the creation and installation of interpretive signage in the WERS food forest, but certain elements were not included in the scope of this document. These next steps are prioritized according to the chronology of sign development and installment. There is also some consideration of time and effort, with steps that are easier to complete ranking higher on the list.

- In-depth visitor assessment: Since the audience profile in "Developing an Interpretive Message" was created without the use of surveys or interviews, there are significant gaps in our understanding of the audience's environmental knowledge. The knowledge of specific subgroups, such as non-environmental studies students or faculty, is less well known. This provides ENV 100 students with the opportunity to collect survey information for the capstone course's analysis. Such a survey could assess the broad environmental knowledge of the campus, or record respondents' impressions of this protocol's signage models.
- Horticulturalist qualifications: Before developing any signage related to the harvest and consumption of edible plant parts, we will need to define what training qualifies an individual to confirm whether or not something can be eaten.
- Secondary color pallet: The secondary color pallet referenced in the "Design Parameters" will be made by the College Communications Office. This pallet should provide the food forest with a wider range of cooler colors and earthy tones that compliment Ursinus' red,

gold, and black color scheme. The pallet will take no more than a couple of weeks to be completed. Submit the request to Dom Monte (dmonte@ursinus.edu).

- WERS logo: Ideally, a unique WERS logo will be developed for the entire site to connect the college identity with the site's purpose. This logo will either accompany or stand-in for the Ursinus shield on food forest signage. The logo will likely be created by the College Communications Office, but could also be created by an interested student with the Communications Office's approval.
- Safety labeling system: The inclusion of health and safety information on the identification makers will need to be easily read and quickly understood by the visitors. We need to develop of an easy to follow coding or labeling system that uses specific colors and symbols to make the distinction between potential allergens, toxic plant parts, and other hazards.
- Installation hierarchy: Funding will not be immediately available to install all of the necessary signage once planting is underway. Within the next year we will need to develop a hierarchy that decides, as the budget becomes available, which signs and how many are purchased for installation.
- Formative evaluation: Signs need to undergo a formative evaluation of both their content and their appearance to ensure the best version of each sign is installed. Ideally, focus groups of school teachers (elementary, middle, and high school), Ursinus community members, and area residents should be created to evaluate these models. Moscardo et al. provide a series of suggestions and questions that can act as a starting point for developing focus group questions (2007).
- Ordering and installation: All campus signage is ordered through Facilities Services. Contact Steve Gehringer (sgehringer@ursinus.edu) when deciding on which signage options to pursue.
- Summative evaluation: Summative evaluations assess whether the signs are attracting attention and clearly communicating the messages they were intended to after they are installed in the site. These can take the form of asking visitors open-ended questions about what they have learned, or through in-site observations (Moscardo et al., 2007). These evaluations should occur at least once shortly after a new sign or new set of signs are installed at the site. Courses with a focus on the interplay of human behavior with our environments (e.g. ENV-216, ENV/PSYC-260, ENV-332, ENV-338, ENV-340, and ENV-454), some of which focus specifically on food producing systems, are best suited to undertake these duties.

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Grover Schrayer, Hopewell Furnace, the Philadelphia Orchard Project, and Catherine Bukowski have been contacted to confirm that their images and figures can be replicated in this protocol, but we have yet to receive a response.