ABSTRACT

Title of Thesis:	HEALING WITH NATURE: INTEGRATING BIODIVERSITY AT MEDSTAR MONTGOMERY MEDICAL CENTER
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This paper addresses the question of whether biodiversity and green infrastructure promote the wellbeing of patients, staff, and visitors in a design intervention for Medstar Montgomery General Hospital. It also addresses the secondary question concerning the relationship between the quantity and quality of biodiversity, green infrastructure, and psychological wellbeing. To produce a design that addresses this question, the author performed a literature review along with research methods such as site inventory and analysis, a preoccupancy assessment tool for gardens, a survey, and a focus group.

HEALING WITH NATURE: INTEGRATING BIODIVERSITY AT MEDSTAR
MONTGOMERY MEDICAL CENTER

by

Jonathan Richard Mallory

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Chapter 1: Introduction

Medstar Montgomery Medical Center (MMMC) is a 138 bed private, non-profit general acute care hospital located in Olney, MD that provides physical and mental health services to the residents of Montgomery County, MD. The campus is comprised of a six-story main building offering the bulk of medical services as well as two office
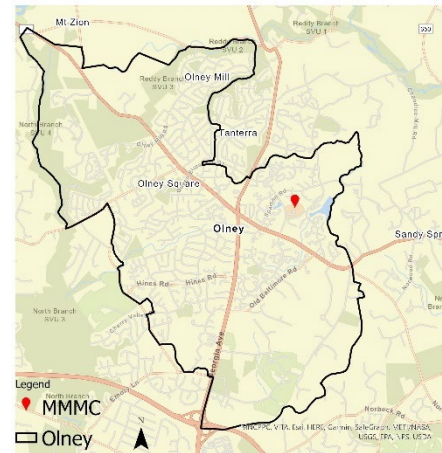
Figure 1: Location map by author

buildings, the cancer center, and a parking garage. The hospital has an abundance of parking, and vehicular circulation takes precedence over pedestrian circulation. The hospital has several garden spaces for patients and families but they are disconnected islands in a sea of asphalt.
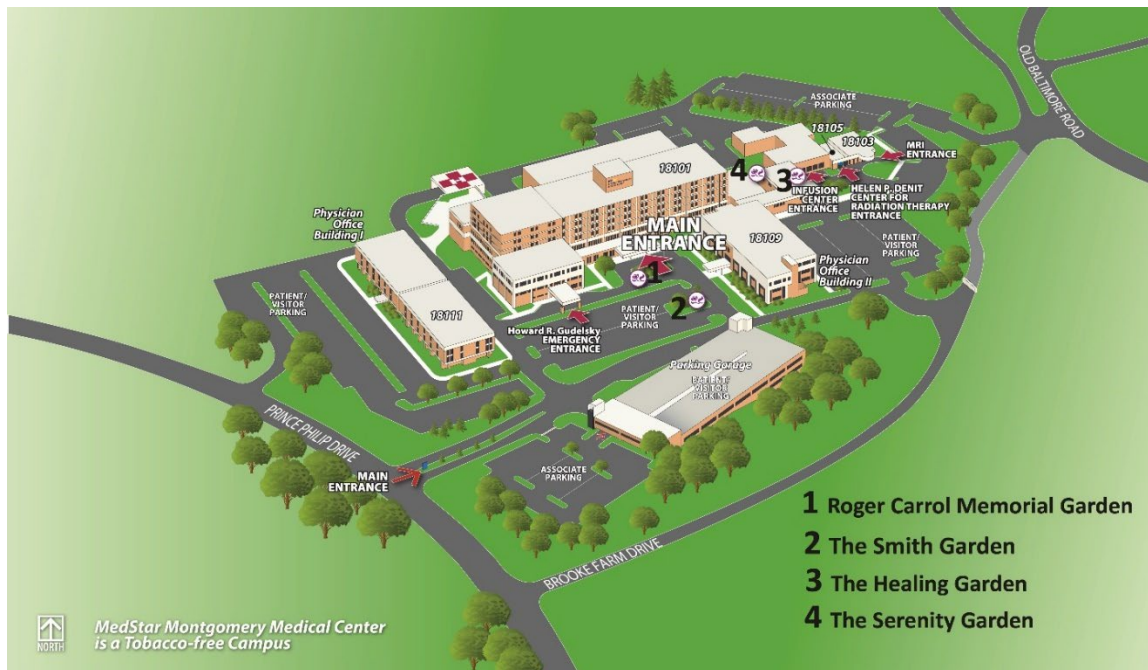
Figure 2: A map of Medstar Montgomery General Medical center by Medstar health.org

The Covid Memorial Garden and Front Entrance Garden

During the summer of 2021, MMMC dedicated the Covid Memorial Garden, located in the eastern portion of the site near a patch of forest and a large detention pond. The Garden is dedicated to staff who endured the Covid pandemic. It is comprised of a paved path terminating in a concrete circle surrounded by three solemn rocks. The garden is five minutes walking distance away from the front entrance of the hospital, and there is currently no accessible path to the garden. The dry detention pond to the south of the site is bereft of vegetation. One of the few easily accessible gardens is the green space located in front of the main entrance of the hospital. The garden is comprised of a few trees in poor health as well as a few clusters of shrubs and black-eyed Susans. The garden also includes two benches of poor quality. These two areas have the most potential for improvement. The Covid Memorial Garden has the potential for

Figure 3 The Covid Memorial Garden. Photograph by Nathan Barbo

Figure 4: The Front Entrance Garden
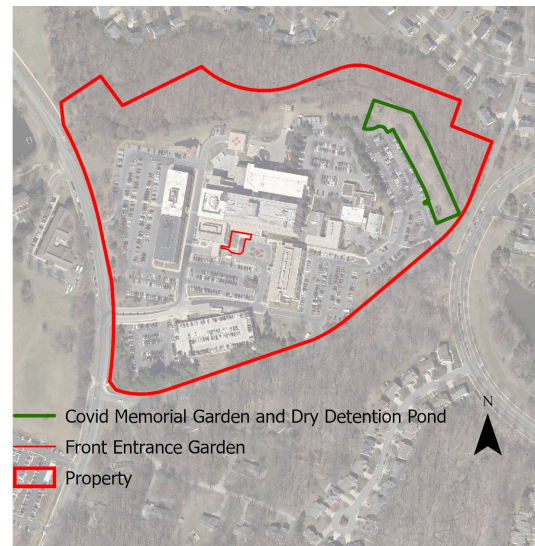
Figure 5: Areas of interest map by author

improved access and the front entrance can be improved by offering more comfortable seating opportunities and colorful vegetation.

The Lack of Accessible and Restorative Garden Spaces

The hospital lacks clear wayfinding to its many garden spaces, and most are not easily accessible to users, particularly those who are less physically able. The existing pedestrian sidewalks terminate in dead ends, forcing pedestrians to walk through parking lots to arrive at the Covid Memorial Garden. This problem discourages people from accessing the restorative benefits of nature, restricting them to a few outdoor spaces and the building interior.

An Opportunity to Connect Garden Spaces that Foster Healing

Medstar Montgomery Medical Center's vision statement is "to be the trusted leader in caring for people and advancing health in the communities we serve" (*Our Hospital | MedStar Montgomery Medical Center | MedStar Health*, n.d.-a). By taking advantage of existing green spaces and enhancing others, MMMC can use its outdoor facilities to better serve its vision to improve health in the surrounding community. These spaces can be used for rest, exercising, and socializing. By connecting these spaces, a journey can be created that minimizes the time users spend walking through parking lots and brings them to spaces surrounded by greenery instead of asphalt.

Developing the Thesis Question

One way of creating healing spaces is by incorporating green infrastructure and biodiversity. Landscape architects are uniquely situated to provide access to well-

designed natural spaces that include these two elements. Biodiversity is defined as "the diversity, abundance and identity of species, their genes and ecosystems and underpins ecosystem services that are essential for human health and well-being (Marselle et al., 2021). This definition of biodiversity is different from the definition used by those in the life sciences (biology, ecology, genetics) (National Research Council (U.S.) Committee on Noneconomic and Economic Value of Biodiversity., 1999). According to the definition used in the life sciences, biodiversity "is the variety of life and its processes. It includes the variety of living organisms, the genetic differences among them, the communities and ecosystems in which they occur, and the ecological and evolutionary processes that keep them functioning, yet ever changing and adapting" (Noss & Cooperrider, 1994, p. 5). The former definition of biodiversity is the definition used in this paper because it considers biodiversity's influence on health and well-being, which is broader than the technical definition offered by the life sciences. Biodiversity is inextricably connected with human values such as health.

According to the World Health Organization, health is "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (*Health and Well-Being*, 1948). Green infrastructure consists of contrived or designed green spaces that provide "social, ecological, and economic functions" in accordance with the intentions of society (Wang & Banzhaf, 2018, p. 768). They are also spaces created for the purpose of stormwater management (US EPA, 2015). For example, a riparian buffer is a form of green infrastructure because it provides economic benefits in the form of stormwater management as well as providing a visual amenity. An ornamental pond is not a form a green infrastructure because while it is a visual amenity,

it plays no role in stormwater management. Incorporating nature into the built environment can be challenging but landscape architects are able to tame the wilderness by containing it within familiar cultural forms people are comfortable with (Fish et al., 2016; Nassauer, 1995; O'Brien et al., 2017).

People are drawn to life. The Biophilia hypothesis posits there is "an innate tendency to focus on life and life like processes" that comes from more than our physical needs, but from our desire to be complete psychologically and physically (Wilson, 1984, p. 31). I hypothesize that green infrastructure and biodiversity can have a healing effect on the human psyche within the context of a healing garden for a hospital. One might argue that if "biophilia" leads to health and well-being, then adding more flora and fauna in a landscape is ideal. Khoo Teck Puat in Singapore is the ultimate example of a hospital that incorporates biophilic design (Green, 2015, p. 98). It includes thousands of plants, urban agriculture, fishponds, and a waterfall designed to decrease stress levels as one enters the grounds (Green, 2015). The hospital also aspires to attract "birds and butterflies" and uses the number of these colorful visitors as a metric of success (Green, 2015, p. 98).

In this thesis I seek to understand how to incorporate green infrastructure and biodiversity within the context of Medstar Montgomery General Hospital in Montgomery County, MD. My thesis primary question asks how biodiversity and green infrastructure can be utilized to foster general health and well-being in the context of a design for Medstar Montgomery Medical Center. My secondary question investigates the relationship between the quantity and quality of biodiversity, green infrastructure, and psychological wellbeing in the proposed design. My goal is to produce a site plan for the

hospital that incorporates biodiversity and green infrastructure and produces a way of designing for the healthcare environment that resembles Khoo Teck Puat rather than the asphalt and concrete that typically greets hospital patients, visitors, and staff. I address this question through a literature review and mixed methods including surveys, focus groups, a garden audit tool, and site inventory and analysis.

Chapter 2: Literature Review

Landscape architects have intuitively understood that exposure to natural scenery restores mental capacity, provides relief from worry, and sharpens the mind. Frederick Law Olmsted, thought of as the founder of the profession of Landscape Architecture in the U.S., reflecting on the beauty of Yosemite National Park, writes somewhat boldly, "It

Figure 6: Parks such as Rock Creek Park offer respite from the everyday cares of life.

is a scientific fact that the occasional contemplation of natural scenes of an impressive character, particularly if this contemplation occurs in connection with relief from ordinary cares, change of air and change of habits, is favorable to the health and vigor of men and especially to the health and vigor of their intellect…" (Dilsaver, 1994, p. 11). Writing on the benefits of urban parks, Olmsted states that parks with ample trees provide "escape from conditions requiring vigilance, wariness, and activity toward other men…" (Glazer & Lilla, 1987, p.37). In informal terms, Olmsted articulated key principles of restorative environments that have since been empirically tested and formalized in theory.

The relationship between nature and preference gains its philosophical and scientific underpinnings in the "biophilia hypothesis" or the preference for life (Kellert & Wilson, 2013, p. 31). This preference "evolved under the influence of hereditary learning propensities"(Kellert & Wilson, 2013, p. 32). In other words, humans are biologically

hardwired to prefer elements of the environment that have historically been important to survival. If humans are innately attracted to beneficial elements of the natural world, then the loss of those elements impoverish the human experience.

<u>*The Biodiversity Health Conceptual Framework*</u>

Two key ingredients in the scenes Olmsted describes include biodiversity and green infrastructure, the abundance of many kinds of wildlife and the ecosystems (forest, meadow, riparian zone) in which they live. Biodiversity and green infrastructure are inextricably related; it is difficult to separate one from the other. Biodiversity is always contextually situated within habitats such as forests and meadows, forms of green infrastructure that provide ecosystem services. Marselle's "pathways-domains conceptual framework" explains how these two components influence aesthetic preference and restoration (Marselle et al., 2021, p. 5). These pathways include "reducing harm, restoring capacities, building capacities, and causing harm" (Marselle et al., 2021, p. 5). Reducing harm refers to mitigating "environmental stressors" (heat and cold), reducing air pollution, and providing medicine (Marselle et al., 2021, p. 6). Restoring capacities refers to recovering one's mental capacities (such as directed attention/focus) from the effects of stress and fatigue (Marselle et al., 2021). Building capacities entails "encouraging physical activity," "facilitating social interaction and cohesion," "transcendent experiences," and "promoting place attachment and place identity" (Marselle et al., 2021, p. 9-10). Lastly, "causing harm" refers to causing fear, producing allergens and "increasing the risk of infectious disease" (Marselle et al., 2021, p.10). This literature review focuses primarily on "restoring capacities" and "building capacities." Sustaining biodiversity is not only ecologically important but is also an important part of

the human experience. Without biodiversity, human health and well-being is decreased.

Restoring Capacities

Studies on natural environments and their restorative psychological and physiological effects assume the evolutionary theory of biophilia. The concept of biophilia is structured into nine "learning rules" or genetically based valuations of nature (Kellert & Wilson, 2013, p. 43). These values humans ascribe to the natural world include the "utilitarian, the naturalistic, the ecologistic-scientific, aesthetic, symbolic, humanistic, moralistic, dominionistic, and negativistic" (Kellert & Wilson, 2013, p. 43). Evolution has wired us not to just appreciate nature for its purely utilitarian value, but also to satisfy a desire for contentment without which we cannot be at peace. The utilitarian value of nature lies in its capacity to fulfill basic human needs such as food, water, shelter, medicine. The naturalistic value refers to the satisfaction of our need for "fascination, wonder, and awe" which nature provides (Kellert & Wilson, 2013, p. 45). The aesthetic value of nature refers to its beauty. This component is not purely biologically based but is also influenced by culture (Kellert & Wilson, 2013). Nevertheless, research has shown that people prefer viewing natural scenery over non-natural or abstract scenes contrived purely by artists such as are found in modern art museums (Ulrich, 1999). People often associate natural elements with their favorite seasons (e.g., the color of fall leaves) over built elements (Kellert & Wilson, 2013). Kellert and Wilson (2013) describe several types of value in nature. The symbolic value of nature refers to its use as a means of "facilitating communication and thought" (Kellert & Wilson, 2013, p. 51). The humanistic value of nature refers to key elements of nature

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that have great emotional and symbolic meaning to humans, such as oak trees. The moralistic value of nature refers to the human intuition that nature provides spiritual enrichment (Kellert & Wilson, 2013). The dominionistic refers to people's desire to control nature for their own ends, and the negativistic value refers to man's fear of certain elements in nature (Kellert & Wilson, 2013).

These values reflect either a preference for/liking of elements of the natural world (biophilia) or dislike of it (biophobia) (Kellert & Wilson, 2013). According to Roger Ulrich, biophilic responses to the natural world are those that restore out mental capacities, elicit a positive aesthetic response, and improve our thinking (Ulrich, 2013). There is little empirical evidence for biophilia, and what little there is approaches it from the angle of aesthetic preference (Ulrich, 2013). Biophobia, however, has much more empirical support (Ulrich, 2013). Tests have shown that people consistently respond with fear to snakes and spiders (Ulrich, 2013). Fear reactions to culturally conditioned factors (guns and barbed wire) were more likely to be forgotten than fear of snakes, suggesting this is hardwired into our genes (Ulrich, 2013). Evidence for biophilia is more indirect as it is approached from the angle of aesthetic preference. Rachel and Stephen Kaplan are well known for their studies on aesthetic preference as well as Roger Ulrich (Ulrich, 2013).

Evolutionary Theories of Restorative Environments

The Kaplans and Roger Ulrich conceived of two distinct psychoevolutionary theories of restorative/aesthetically pleasing environments that scientifically substantiate Olmsted's intuition of the healing effects of nature. These two theories do more than explain how and why natural environments are restorative; they serve as the basis for

specific healing environments such as healing gardens. The definition of "nature" and "natural" do not align with the definition used by ecologists and biologists. For the purposes of this research, nature is used in its connotative sense rather than its denotative sense, encompassing what people commonly think of as "nature": vegetation and managed, landscaped areas. This definition is shared by key researchers in the area of landscape aesthetics and environmental psychology such as Roger Ulrich (1991), the Kaplans (2001), and Joan Nassauer (1995). The Kaplans' Attention Restoration Theory (ART) and Ulrich's Stress Reduction Theory (SRT) explain the role of aesthetic/affective response to preferred environments, its role in human evolution, and its connection to psychological (and in Ulrich's case physiological) restoration. I will further describe each theory, and how they differ from each other, below.

ART and SRT share one common assumption: Evolution has wired humans to relate to information in their environment. We intuitively grasp the advantages and disadvantages of our environment to health and wellbeing in the form of aesthetic preferences learned through evolution (Kaplan & Kaplan, 1989); Ulrich, 1983). Rachel and Stephen Kaplan write, "humans judge situations with such facility that they are often not aware of the fact that such an evaluation is occurring" (Kaplan & Kaplan, 1989, p. 5). Humans process the negative and positive aspects of their environment unconsciously (Urich, 1983).

Attention Restoration Theory

The Kaplans' theory of preference, attention restoration theory (ART), is divided into "content based categories" and "spatial configuration categories" (Kaplan & Kaplan, 1989, p. 26). Content based categories refer to the ratio of built and natural content in a

scene. Spatial configuration categories refer to the degree of openness and depth in a

landscape (Kaplan & Kaplan, 1989). The results from a study comparing scenes with

natural and built content suggest that people prefer environments where the ratio of

natural to built elements favors natural elements. Participants preferred natural scenes

with built elements such as boardwalks, small landscape structures (e.g., gazebos,

pergolas), and scenes with boats. Entirely natural scenes also had high preference ratings,

particularly those with dominant features such as

mountains (Kaplan & Kaplan, 1989). This study alone

has important implications for designers. Preference is

not a black and white rejection of built elements and

attraction to nature; rather, various combinations of

natural and built components elicit preference, albeit

those higher in natural content. Regarding spatial

configuration categories, the Kaplans' studies found

people prefer environments "open, yet defined"

including "smooth ground textures" and trees that "help

define the depth" of the environment (Kaplan &

Figure 7: This natural scene has the preferred ratio of natural to build elements. The boardwalk structures the scene. People can enjoy the biodiverse plants while being safely above them.

Kaplan, 1989, p. 49). People are averse to environments that are too open with no objects

in the foreground and environments that are too dense or obstructing. These open yet

defined landscapes are termed "savannahs," and preference for these kinds of

environments is well supported by the literature (Kaplan & Kaplan, 1989, p. 48).

 In order to explain how people process information and its relationship to

aesthetic response, the Kaplans came up with the "preference matrix" (Kaplan & Kaplan,

1989, p. 49). The preference matrix assumes people relate to information in their environment in two ways. People are driven to satisfy the need for understanding and exploration and need time to process important information. People need to comprehend their environment to feel safe, and it needs to hold the possibility for further exploration to be interesting. The preference matrix also presupposes that the degree of interpretation one needs to process information from the environment exists along a continuum from the need for little inference to the need for greater inference (Kaplan & Kaplan, 1989). Two aspects of the environment easily grasped include "coherence" and "complexity" (Kaplan & Kaplan, 1989). A coherent environment is one in which the "patterns of brightness, size, and texture" are organized (Kaplan & Kaplan, 1989, p. 54). Complexity refers to "the number of visual elements in a scene; how intricate the scene is; its richness" (Kaplan & Kaplan, 1989, p. 53). Complexity provides content or "things to think about" (Kaplan & Kaplan, 1989, p. 53). The concept of complexity is the most relevant for this

Figure 8: In this reimagining of a courtyard in Walter Reed, the waterfall is dominant over all the other elements, making this scene legible.

thesis as it comprises the elements of biodiversity and green infrastructure. The final two components of the preference matrix—legibility, and mystery—require higher levels of inference and hence, more effort. A legible space is one that is "easy to understand and remember" (Kaplan & Kaplan, 1989, p. 55). The elements of the scene are rightly ordered in a relationship that makes the environment easy to navigate. A good example of a legible scene would be one in which an element is dominant over the others (a

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mountain, a piece of art, and so on) and serves as a landmark. Mystery refers to the promise of more information in one's environment (Kaplan and Kaplan, 1989). A bend around the path or a view partially

Figure 9: Patterns of light and shadow in this image along with the diverse vegetation evoke soft fascination.

obscured by foliage represent mystery. Including a variety of biodiverse plants along a winding walk may evoke mystery, encouraging people to investigate.

ART relies on the concept of directed attention fatigue to explain how natural environments promote restoration. Directed attention refers to the mental capacity of humans to focus their attention on a task despite distractions (Kaplan, 1995). This capacity takes mental effort and can become fatigued, resulting in tiredness, irritability, and inability to focus on important tasks such as one's job, parenting, and so on. Natural environments have the potential to restore this capacity through "fascination," or involuntary attention effortlessly directed toward an object of interest (Kaplan, 1995). Three other factors also effect the restorative outcome: Compatibility (the harmony of what one wants with what the environment has to offer), being away (being away from the ordinary cares of life), and extent (the sense of being in a different place) (Kaplan, 1995). According to the Kaplans' research, the environment that elicits the most restoration is one the evokes "soft fascination," holding one's attention but in an "undramatic fashion" (Kaplan, 1995, p. 174). These landscapes consist of "sunsets, cloud patterns, and leaves in a breeze" (Kaplan, 1995, p. 174). Soft fascination enables the capacity for reflection, a potential restorative benefit (Kaplan, 2004b). Reflection is

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defined as the ability to consciously or unconsciously engage in problem solving to find a solution to an unfinished problem (Kaplan, 2004b). Soft fascination allows one to pierce the mental clutter that runs through the overwhelmed mind, preventing the person from solving real problems in life (Kaplan, 2004b). Soft fascination does not cure this state of being, but it mitigates mental anguish, leaving enough mental room for reflection (Kaplan, 2004b).

Further and more recent research provides support that natural environments can mitigate the mental clutter that runs through our minds. In a study conducted by Dr. Gregory Bratman, participants recorded the weekly amount of time they spent in nature, the duration of ruminative thought patterns, and positive as well as negative feelings on a Likert scale (Bratman et al., 2021). Rumination, a mediator of negative affect is a maladaptive thought pattern concerning negative events in one's life or the failure to attain life goals (Bratman et al., 2021). Bratman's study investigated three hypotheses. First, the "average weekly time spent in nature" would increase positive emotions and decrease negative ones (Bratman et al., 2021, p. 2). Second, "average weekly time spent in nature" would likely be correlated with decreased rumination (Bratman et al., 2021, p. 2). Lastly, "average weekly time spent in nature" would indirectly increase positive emotions by reducing rumination, which enables/mediates negative emotions (Bratman et al., 2021, p .2). The results of the study showed an association, but not a causal one, between time spent in nature and rumination, positive emotions, and negative emotions (Bratman et al, 2021). Time spent in nature was associated with increased positive affect and decreased negative affect (Bratman et al, 2021). Time spent in nature was also "inversely associated with rumination" (Bratman et al., 2021, p. 4). Although the study

did not demonstrate a causal link, Bratman speculates on possible causal mechanisms behind the results. Because nature exposure restores directed attention, individuals may experience more control over negative thought patterns, decreasing rumination (Bratman et al, 2021). Furthermore, the natural stimuli may lead people to not focus on themselves so much (Bratman et al, 2021).

The inclusion of various kinds of plants and animals may heighten the potential for natural environments to distract people via fascination and curiosity (Bratman et al, 2021). A depressed individual walking through a hospital garden may be forced out of her ruminative thinking by the sudden appearance of winged visitors such as birds and butterflies. The appearance of these creatures may be enough to surprise someone but in an unthreatening way. The second causal mechanism

Figure 10: This viburnum species caught my eye and prompted me to investigate it.

may be that natural environments contain fewer reminders of the failure to attain one's goals (Bratman et al, 2021). Urban environments may contain signs and advertisements reminding people of what they lack, such as good jobs, or comfortable living (Bratman et al, 2021). Lastly, the environment itself may be a necessary and sufficient condition for rumination (Bratman et al, 2021). Negative association of thoughts with the environment may be ameliorated by situating oneself in an altogether different environment full of more positive distractions such as wildlife. Biodiversity's benefits extend from the

psychological to the physiological. Biodiversity not only facilitates attention restoration but also helps reduce physical symptoms of stress.

Stress Reduction Theory

Ulrich's Stress Reduction Theory (SRT) differs from the Kaplans' ART in that it focuses on stress, a physiological response, rather than fatigue, which is psychological. Like ART, it explains how environments are restorative by describing our aesthetic/affective responses to such environments. Ulrich defines such a response as a "preference or like-dislike affect in association with pleasurable feelings and neurophysiological activity elicited by a visual encounter with a natural setting" (Ulrich, 1983, p. 87). Evolution has adapted humans to respond emotionally to their environments as a way of signaling the environment's desirable and undesirable characteristics (Ulrich, 1983). Emotions also serve to bodily prepare the individual for the appropriate adaptive response such as fight or flight (Ulrich, 1983). When people first behold a new environment such as the forest interior, their responses are conditioned by their current emotional state, influencing what elements of the scene they focus on (Ulrich, 1983). Depending on what they observe, another affective state is triggered

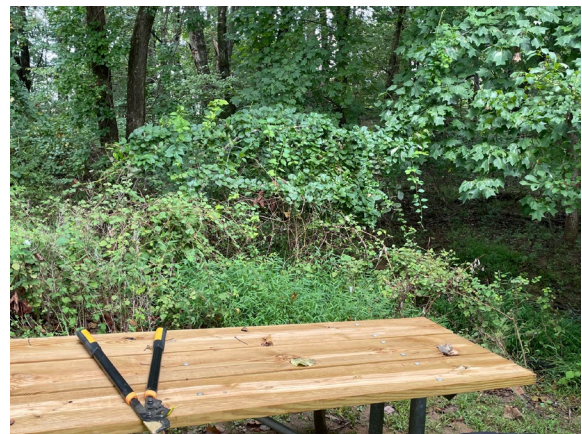*Figure 11: The forest edge of Medstar Montgomery Medical Center illustrates Ulrich's point that dense vegetation can be overwhelming and elicit fear.*

("like, dislike, or fear") which influences "approach-avoidance" behaviors (Ulrich, 1983, p. 89). For example, someone in a fearful state of mind might notice dense, impenetrable thickets blocking her path, which elicits dislike, motivating an avoidance response

(Ulrich, 1983). A forest that has numerous invasive species in it such as oriental bittersweet and mile-a-minute vine would be frightening and not restorative. This kind of biodiversity is undesirable. After the affective response, a process of "cognitive evaluation" ensues (Ulrich, 1983, p. 92). This evaluation will require less effort if the environment possesses "organizational properties" such as "depth cues"

Figure 12: Figure 3 Lake Frank in Rock Creek Park illustrates the pleasing combination of depth, vegetation, and water.

that help the individual to navigate their environment (Ulrich, 1983, p. 92). This property is like the Kaplans' concepts of coherence and legibility. The process of cognitive evaluation may trigger memories, which may trigger further emotions, adding to the emotional complexity of the experience. The organizational properties of the environment consist of "configurational or structural aspects of a setting," "gross depth properties that require little inference," and "general classes of environmental content" (Ulrich, 1983, p. 98). Structural properties include organizing features such as focal areas and patterns that work with innate human preferences to rapidly communicate the most important elements of a setting. Content such as water and vegetation also aid in signaling whether in environment is preferable or not. Depth refers to the degree an environment is open or not open, affecting visibility (Ulrich, 1983). Another visual property affecting aesthetic preference is "complexity," a term encountered in the summary of ART (Ulrich, 1983, p. 95). Ulrich's definition is virtually identical to the Kaplans' definition in that complexity refers to "independently perceived elements in a

scene" (Ulrich, 1983, p. 95). Species diversity is specifically listed as being an element of complexity (Ulrich, 1983).

Structural properties of setting, depth cues, and complexity work in tandem to elicit the aesthetic response (Ulrich, 1983). Scenes are preferred that possess "moderate to high" complexity structured by patterns or visual aids such as focal points (Ulrich, 1983, p. 105). The depth of the environment should me medium to high and be "perceived unambiguously" (Ulrich, 1983, p. 105). Like the Kaplans, Ulrich emphasizes that an open environment with enough trees providing depth is more preferred than environments with a dense amount of trees or a view that is too open (Ulrich, 1983). The preferred environment also includes smooth, even ground textures, "deflected vistas" to encourage exploration, and water (Ulrich, 1983, p 105). These findings have been shown to be true across cultures, strengthening the view that these preferences are a result of human evolution (Ulrich, 1983). Furthermore, natural environments are preferred to environments comprised of mostly built elements (Ulrich, 1983).

Ulrich, like the Kaplans, shows that environments that elicit positive aesthetic preference can also be restorative. An experiment performed in Sweden, using EEG monitoring, tracked participants' brain waves (Ulrich, 1983). Participants viewing more "natural scenes" had higher alpha waves, indicating a state of wakeful relaxation (Ulrich, 1983, p. 114). Alpha waves are indicative of "quietly flowing thoughts" and "meditative states" (Ulrich, 1983, p. 114). Another study included 120 persons who were shown a "stressful movie" and were then shown images of natural and built settings (Ulrich et al., 1991, p. 201). Physiological measures indicating a stress state were taken such as "heart rate, skin conductance, muscle tension, and pulse transit time" (Ulrich et al, 1991, p.

201). A self-report questionnaire measuring participants' emotional response was also used (Ulrich et al, 1991). The results from both tests indicated that "recuperation from stress was faster and more complete when people were exposed to the natural setting" (Ulrich et al 1991, p. 222). These studies indicate that natural scenes not only promote psychological restoration but restore some measure of physiological health. As noted above, natural elements such as trees and other vegetation should not overwhelm the viewer. Built elements and the provision of open spaces help moderate the complex natural scenes often have.

Biodiversity's Relation to Attention Restoration Theory and Stress Reduction Theory

The connection with biodiversity/green infrastructure and the theories of ART ad SRT has grown within the past two decades of research. Two studies on forest bathing reinforce Ulrich's findings that natural environments enhance physiological and psychological wellbeing. Forest bathing "refers to immersing oneself in nature and experiencing a forest's atmosphere to improve mental and physical health" (Yu et al., 2017, p. 2). Several studies have shown that forest bathing's physiological benefits include reduced cortisol, lowered blood pressure, and a strengthened immune system (Yu et al., 2017). The Xitou Nature Education Area study conducted by National Taiwan University has further refined research on forest bathing by analyzing its effects on the "autonomic nervous system activity and emotions" on the middle aged and elderly (Yu et al., 2017, p. 2). After two hours of exposure, results showed decreased blood pressure and reduced stress, providing further evidence for SRT. Participants scored lower on negative emotion scores such as "fatigue-inertia" and "tension-anxiety" and scored higher on the

category of "vigor-activity" providing support for ART (Yu et al., 2017, p. 8). Another

study in Taiwan conducted with 16 middle aged women who experienced a longer, two-

day event in which they experienced forest bathing showed similar results (Chen et al.,

2018). Further research has shown that there is a

relationship between chemicals called

phytoncides (wood essential oils) and an

increase in natural killer cells (cells that kill

cancer and virus infected cells) (Li, 2010).

Phytoncides work synergistically with the

stress-decreasing effects of forest bathing to

increase natural killer cell count (Li, 2010). This

research is significant for understanding how

*Figure 13: A walk through these woods is more
than just a breath of fresh air but also decreases
stress.*

biodiversity can affect psychological and

physiological restoration. The habitat of the forest should be utilized in landscape design
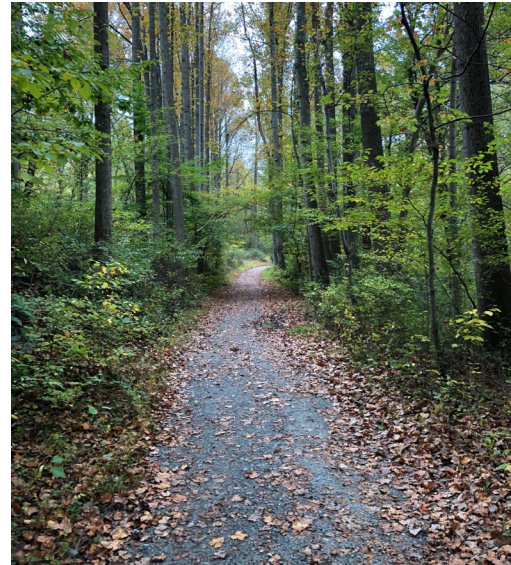
when appropriate to facilitate ART and SRT.

     Additional research by the Kaplans and other scholars affirms that the forest

interior has the most potential for attention restoration than other ecosystems such as

meadows or the forest edge (Chiang et al., 2017, 2017; R. Kaplan, 2001; S. Kaplan,

2004b). As mentioned before, environments with soft fascination tend to be more

restorative than those with "dramatic" kinds of fascination (i.e., environments containing

elaborate, complicated art). This is because such environments foster reflection. Stephen

Kaplan cites research in which AIDS caregivers were studied to discover how some of

them avoided burnout (Kaplan, 2004b). The caregivers who engaged in quiet, nature-

based activities enabling reflection were likely to avoid burnout more than those who turned to more intense forms of fascination such as watching television (Kaplan, 2004b). It is the quiet, unassuming environments such as forest patches that may not be considered the most aesthetically pleasing that provide the most restoration (Kaplan, 2004b).

In Rachel Kaplan's study entitled "The View From Home," she selected participants from six apartments in Ann Arbor, Michigan to answer a survey that contained window views of natural and built elements (Kaplan, 2001). The purpose was to measure aspects of wellbeing such as mental fatigue and positive affective states connected to restoration ("feeling relaxed and effective") (Kaplan, 2001, p. 512). Natural scenes consisted of unmanaged woodland, lawns interspersed with trees, gardens, trees, and flowers. The participants' satisfaction with nature and their neighborhood was also measured (Kaplan, 2001). Satisfaction with neighborhood is associated with a sense of "security and community" whereas satisfaction with nature focused on different types of vegetated areas such as open space with grass, trees, and other natural elements (Kaplan, 2001, p. 527). The results of the survey show that gardens and flowers are associated with satisfaction (neighborhood satisfaction and natural satisfaction) and affective functioning. Views of trees, however, were associated with a higher sense of "being restored" in the form of "having one's directed attention intact" (Kaplan, 2001, p. 533). The most preferred scenes included those with "unmanaged woodland" despite it being considered less aesthetically pleasing than gardens or lawns interspersed with trees (Kaplan, 2001, p. 528). Participants, however, also placed value on "large mowed areas" as being a part of both satisfaction with nature and satisfaction with one's neighborhood (Kaplan, 2001, p.

538). This suggests that having both kinds of views is important because without a sense of security (knowledge that civilization is in proximity), it is unlikely the unmanaged woodland alone will be restorative.

A more recent study also shows that the forest environment, particularly the forest interior, can elicit greater restoration than other environments. The study investigated the restorative effects of three areas of a forest patch (the inner, the edge, and the outer) using EEG monitoring as well as attention and stress (physiological and psychological) tests and compared the results (Chiang et al., 2017. Even though the forest is not as biologically diverse as the forest edge, participants had higher alpha waves and higher rates of stress recovery (Chiang et al., 2017). While this study did not investigate the causal relationship between the forest interior and restoration, several reasons might exist for why the interior is the preferred environment. Unlike the forest edge and the exterior, vegetation in the forest is more structured, with tall straight trees (Chiang et al., 2017). Anyone who has walked a mowed path through a meadow knows the vegetation can be chaotic, with tall grasses obstructing the view, decreasing one's sense of safety. The enclosed structure of the forest interior creates a world of its own, fostering a sense of "being away," an aspect of restorative environments (Chiang et al., 2017, p. 80). Research on the relationship between vegetation density and restoration/preference shows that people prefer medium density even though "high density vegetation shows optimum restoration" (Chiang et al., 2017, p. 80). Vegetation density will be discussed later in this thesis because while density may be important, providing enough openness to provide a sense of safety is also important to wellbeing.

Specific kinds of flora and fauna are especially aesthetically pleasing and contribute to restoration. Two studies show that trees with fall color contribute more to attention restoration than plants without seasonal variation due to increased fascination. One study examined the effects of seasonal color on patients with psychotic disorders while the other examined the effects of fall color on attention/emotional wellbeing at an underserved elementary school. In the first study, 25 patients with psychotic disorders such as schizophrenia were shown computer generated imagery depicting seasonal color or lack thereof (Paraskevopoulou et al., 2018). Eye tracking and facial expressions were recorded to measure emotional response and fixation. The study shows that the most preferred plant for seasonal variation for this group of participants includes trees (Paraskevopoulou et al., 2018).

The purpose of the second study was to investigate the impact of seasonal variation in deciduous trees on children and how children perceived their "restorative effects" (Paddle & Gilliland, 2016, p. 1). The study also investigated whether or not evergreen, coniferous plants "extended these restorative effects" into the winter (Paddle & Gilliland, 2016, p. 14). The study utilized a Sketchup model of the site to depict seasonal variation over time along with a survey to test the extent the children experienced fascination, being away, extent, and compatibility. The scenes included how the school looked in the growing season, in fall, and in winter (one scene with evergreens and the other without). The results showed that fall was the most restorative scene and winter the least restorative scene (Paddle & Gilliland, 2016). The scene of winter with evergreens "was rated significantly more restorative than the leafless scene without evergreens" (Paddle & Gilliland, 2016, p. 12). Seasonal color may facilitate restoration

because research has shown certain foliage colors elicit certain feelings (Paraskevopoulou et al., 2018). Green-yellow foliage evokes "cheerfulness, comfort, and calmness" while red and dark green foliage "developed a sense of strength and tension" (Paraskevopoulou et al., 2018, p. 51). Other colors also influence one's affective state. Cool pastels such as purple, blue, and cool greens also have a calming effect whereas warm colors such as red, orange, and yellow stimulate the mind via distraction and can be "uplifting" (Paraskevopoulou et al., 2018, p. 51). For hospital patients and staff, who are overwhelmed and can suffer from the effects of stress and attention fatigue, these color combinations can calm the mind while providing enough distraction to mitigate distress. In other words, seasonal color can be a mediator of soft fascination.

Animal species diversity can also contribute to or hinder restoration. Tree and avian biodiversity is correlated with higher levels of "vitality and positive affect" (Wolf et al., 2017, p. 1). A study about the relationship of avian biodiversity to emotion asked participants who visited a series of parks to record their perception of avian biodiversity along with their affective states (Cameron et al., 2020). The study also investigated the relationship of avian abundance with one's affective state. The study showed that avian biodiversity, not avian abundance, was associated with greater happiness (Cameron et al., 2020).. Hence, designers should be aware of what birds their design interventions might attract. A large retention pond in a hospital garden may not be ideal as ponds tend to attract masses of messy birds such as Canada geese. The view of a bright red cardinal next to a bluebird might elicit a more positive affect, as these birds are highly valued for their color.

Perceived Sensory Dimensions

After the formulation of ART, researchers sought to expand the theory by discovering more restorative experience within the natural environment (Stigsdotter et al., 2017). The "offspring" of this research is the concept of "perceived sensory dimensions" (Stigsdotter et al., 2017, p. 2). The concept of perceived sensory dimensions (PSDs) arose out of a study in Sweden investigating the relationship between stress and green space (Stigsdotter et al., 2010). Participants answered a survey inquiring about demographics, preferences for certain qualities in green spaces, and self-assessed health (Grahn & Stigsdotter, 2010). From their research, eight "perceived dimensions" of an environment associated with feelings of stress relief emerged. These include "serene (silent and calm), space (spacious and free), nature (wild and untouched), rich in species (several animals and plants), refuge (safe, benches, play equipment), culture (decorated with fountains and ornamental plants), prospect (flat and well cut grass surfaces and vistas, and social (entertainment…)" (Stigsdotter & Grahn, 2011, p. 296). The four sensory dimensions strongly correlated with feelings of psychological restoration include serene, refuge, rich in species, and nature (Stigsdotter et al., 2017). A study of the healing forest of Octavia in Denmark investigated how participants experienced psychological restoration in relation to each of the PSDS. The healing forest is divided into eight rooms representing the eight PSDs, allowing the researchers to analyze the effects of each PSD. The study also investigated the spatial characteristics of the forest most relevant to restoration (Stigsdotter et al., 2017). The rooms participants rated as restorative from greatest to least are the ones corresponding to "serene, rich in species, nature, and refuge" (Stigsdotter et al., 2017, p. 5). The room corresponding to "serene" consists of a path emerging from the

forest that terminates at a large, open pond. The space evokes a simultaneous feeling of privacy and openness due to the dense forest at one's back and the broad view of the pond in front. The room corresponding to "rich in species" consists of a forest clearing with a little pond surrounded by smaller trees. Participants found this site appealing because the circular enclosure provided a sense of safety while the layered structure of the plants and their color provided fascination (Stigsdotter et al., 2017). The room corresponding to "nature" consists of tall, somber pine trees meant to symbolize "stability" (Stigsdotter et al., 2017, p. 9). One participant noted the strong vertical dimensions of the tree encouraged reflection. The room representing "refuge" includes a weeping beech and benches backed by shrubs and trees. Participants rated this room as feeling more contrived compared to the other three rooms but appreciated its openness and enclosure (Stigsdotter et al., 2017).

Building Capacities

Psychological wellbeing entails more than just having one's cognitive capacities restored. Getting out of one's own comfort zone, building relationships, and learning new skills and hobbies are also essential to one's health and wellbeing. Environmental psychologists sometimes use the word "instoration" to express benefits received from restorative environments by healthy individuals (Korpela & Ratcliffe, 2021, p. 1). These benefits can include increased feelings of calmness and clarity of mind (Korpela & Ratcliffe, 2021).

The theoretical frameworks explaining how biodiversity/green infrastructure can contribute to the building capacities pathway lies in the cultural ecosystem services model and in the concept of cues to care. The cultural ecosystem services model posits

that ecosystems are dynamic spaces that facilitate the interaction of people with their environment and with each other (Fish et al., 2016; O'Brien et al., 2017). "Cultural practices," the interactions that take place between people and the environment, work synergistically with those spaces that enable them and shape them in turn (Fish et al., 2016, p. 6). Strolling through a park is an example of a cultural activity which in turn might inspire the user to care for nature, prompting her to volunteer to care for it thereby influencing the environment. The interaction of cultural practices and the natural environment produces "cultural ecosystem benefits" which help cement a person's "identity," enriches her "experience," and enhances her "capabilities" (Fish et al., 2016, p. 4). Identity can refer to one's sense of "belonging" and experience can entail "escape and tranquility", while capability can refer to "health and knowledge" (Fish et al., 2016, p. 6). Cultural practices that work in tandem with green infrastructure include "recreational activities" such as "playing and exercising," "gathering and consuming," "producing and caring," and "creating and expressing" (Fish et al., 2016, p. 6; O'Brien et al., 2017, p. 240). The cultural ecosystem benefits associated with these interactions include the emotional benefits of "escape, freedom, and enjoyment" provided by the "complex and diverse" elements found in green infrastructure (O'Brien et al., 2017, p. 240).

The aesthetics and structure of an environment play a role in influencing whether a person will be motivated to take care of the environment. An example from my own experience is Brookside Gardens, a public garden in Wheaton, MD. This place has deep significance for many people as it is a place where weddings and other celebrations are held. It is a place of cultural enrichment. The grounds are maintained by volunteers as

well as professional horticulturists. The experience of the garden is what prompts those with spare time to help take care of it. The choreography of the spaces, the planting design, and the strategic placement of seating work together to create a culturally significant space. Joan Nassauer terms these patterns in the environment "cues to care" (Nassauer, 1995, p. 161). A common example of a pattern Nassauer cites is corn being planted in rows (Nassauer, 1995). In order for biodiverse habitats and green infrastructure to be aesthetically appealing, they need to be framed in culturally appropriate forms (Nassauer, 1995). A good example of an attractive form of green infrastructure that is framed appropriately would be a rain garden planted next to a curb cut on the road. The curb and the street quite literally frame the garden, giving it order that someone can understand. This is necessary for an environment to feel safe and secure when elements of complexity, such as biodiversity or a large amount of green infrastructure, are added. Nassauer's frames are the filter through which cultural ecosystem benefits and restorative environments must pass before they can truly be restorative.

Green Infrastructure and Preference

As noted earlier, complexity, or the number of visual elements in a scene, influence whether an environment is restorative or not. It might also influence a person's desire to take care of it or escape from it. A form of green infrastructure such as a bioswale may be full of biodiverse vegetation but if the vegetation density is too great, people may be tempted to avoid it rather than help to take care of it. Hence, the complexity of an environment can influence social or antisocial behavior. In a study of green infrastructure (trees, bioretention, and other vegetation) along an urban street, the

mathematic relationship between preference for overall vegetation density, understory layer density, and tree density was represented by a power curve (Suppakittpaisarn et al., 2019). As complexity increases, the curve begins to flatten, signaling that more vegetation complexity will not yield higher

Figure 14: If bioretention is not consistently maintained, it can become an unsightly mess

preference, but nor will it be regarded negatively (Suppakittpaisarn et al., 2019). This implies it is difficult to add too much canopy and understory vegetation in a highly structured environment. The relationship between bioretention density and preference "fitted equally between a liner or a power curve" (Suppakittpaisarn et al., 2019, p. 241). This preference study took place in an urban context and did not compare it to a "natural" one. The strong linear feature of the road, the vertical elements of the building, and the sidewalks also helped order the vegetation complexity of the scene (Suppakittpaisarn et al., 2019). This study suggests that the threshold for an environment to feel overwhelming and unsafe increases with the number of built elements in the scene.

In another study examining the relationship of green stormwater infrastructure and preference (tree cover and bioretention), researchers wanted to know how much green infrastructure influences perceived "naturalness, safety, and messiness" via a photo questionnaire (Suppakittpaisarn et al., 2020, p. 3). The results showed that increased tree cover was associated with higher levels of naturalness and perceived safety (Suppakittpaisarn et al., 2020). Higher bioretention was associated with messiness. The

study implies that green infrastructure is perceived as aesthetically pleasing only insofar as people feel safe and see it as natural (Suppakittpaisarn et al., 2020). One study in a rural context, examining preference for riparian buffers, found that people preferred these areas for their "ecological benefits and aesthetics" but were concerned about consistent maintenance (Kenwick et al., 2009, p. 93). Preference for the kind and density of green infrastructure suggest that people are appreciative of nature, but this must be balanced with the desire for safety and cleanliness. One way of possibly getting people more comfortable with dense bioretention is to educate them about the value through learning walks or educational signage. In this way, green infrastructure can provide an opportunity to build capacities in the form of increasing peoples' observational skills

Perceived Sensory Dimensions

Perceived Sensory Dimensions (PSDs) not only facilitate restoration, they also help build capacities. A study investigating the relationship between "activity types, the PSDs of greenspace, and level of stress" examined four restorative activities and their association with PSDs. These include "walking activities," "animal activities (studying animals)," "being in peace activities (searching for peace)",

Figure 15: The PSD "rich in species" is associated with walking.

"gathering activities (outing with one's family)", and "rest activities (getting fresh air, watching wild plants)" (Stigsdotter & Grahn, 2011, p. 300). When paired with a PSD, the resulting combination is termed a "activity-sensory dimension type" (Stigsdotter & Grahn, 2011, p. 300). Participants in the study answered a survey and the researchers

found walking activities, restful activities, and animal activities to be the most preferred

activity types for stressed individuals in a natural environment (Stigsdotter & Grahn,

2011). Rest activities, walking activities, and animal activities are associated with the

PSD "rich in species" (Stigsdotter & Grahn, 2011, p. 300). Of these, participants

especially preferred walking activities and restful activities (Stigsdotter & Grahn, 2011).

Activities such as walking and observing animals not only facilitate psychological

restoration, but also build capacities such as

endurance and observational skills (Stigsdotter &

Grahn, 2011). This could lead to the development of

healthy habits such as exercising or bird watching,

strengthening the relationship of the individual to the

environment.

Figure 16: Animal activities such as bird watching are associated with the PSD "rich in species"

Contemplation

A key skill for managing the

effects of stress and fatigue is

contemplation. In relation to the

landscape, contemplation is defined as a

"fixed attention, an elimination of

thought, an inner orientation of oneself,

and the reaching of inner silence"

(Olszewska et al., 2018, p. 8). In a study

investigating the association of elements

Figure 17: The Covid Memorial Garden has three landscape elements associated with contemplation: "big stone", forest", and "circle" (Olszewska et al., 2018, p. 8)

and spatial structures of a landscape with contemplation, it is further associated with

"passive recreation" and restorative benefits natural landscapes offer (Olszewska et al., 2018, p. 8). Contemplation differs from reflection because the intent is to quiet the mind from mental noise and not to solve a problem in spite it, aided by soft fascination. In the literature review, the landscape elements associated with contemplation include "path, still water, waterfall, single old tree, big stone, clearing, forest, grave, and circle" (Olszewska et al., 2018, p. 8). Spatial features of contemplative environments include "canopied, enclosed, focal, and panoramic" (Olszewska et al., 2018, p. 17). Experts in landscape design answered a photo questionnaire that asked them to rate different kinds of natural environments with varying spatial structures (canopied, enclosed, etc.) as more or least contemplative (Olszewska et al., 2018). Professionals rated the panoramic and focal landscapes as most contemplative and the canopied and enclosed landscapes as least contemplative (Olszewska et al., 2018). Contemplative landscapes bear resemblance to the outdoor rooms of the Octavia healing forest in Denmark. Rooms three and four, corresponding to "rich in species" and "serene", offer panoramic views. Room three accomplishes this by providing a broad view of the lake while room four's circular shape provides a broad, open view. The diverse vegetation in room four provides that appropriate ambiance for reaching inner silence. Room two, corresponding to the PSD "prospect" offers a potential focal view by virtue of its linear, road-like shape (Stigsdotter et al., 2017). Due to the absence of a clear end point, participants described it as "bare" and "highway like" (Stigsdotter et al., 2017, p. 5). The addition of a unique feature such as a gnarled tree or fountain might transform this room from a mere "road" to a place where one's attention gravitates to the focal point, however that is achieved (Stigsdotter et al., 2017). Lastly, a contemplative landscape need not rigidly follow the

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recommendations in the study (Olszewska et al., 2018). The preferences of professional

designers and the preferences of the public do not always coincide. Just as ecologists may

object to the definition of "nature" and "natural" used in landscape aesthetics, the

public's view of a "contemplative landscape" may be different. As noted earlier, people

prefer the forest interior and sheltered landscapes that simultaneously offer views.

Affordances

To design outdoor spaces that offer the

opportunity for building capacities, it is helpful

to know what people want to do in their

environment and how elements of those

environment can be used to accomplish those

ends. An affordance, a term coined by James

Gibson, is the awareness of the range of possible

actions presented by objects in the environment

Figure 18: A single specimen tree can be an affordance for contemplation. You don't always need a lot of species to produce a desired effect.

(Hadavi et al., 2015). Hence, a bench offers the opportunity for seating as well as an

object one can stand on to get a better view. Affordances can be "social activities",

"rest/restoration activities", walking activities, and so on (Hadavi et al., 2015, p. 24). A

study investigating preference for landscape elements offering a variety of affordances

used photos and allowed participants to select photos, pairing them and grouping them

(Hadavi et al., 2015). The most preferred images contained seasonal color, allees of trees,

copses of trees, single specimen trees, flowers, benches, and shade. Participants who

preferred the "rest/restoration" affordances described the images of shade and seating as

being "serene" spots where one could "read a book" (Hadavi et al., 2015, p. 24). People

also preferred winding paths planted with flowers or small shrubs and "formal vegetable rows" (in community gardens), showing the role of cues to care (Hadavi et al., 2015, p. 28). The spaces of the scene also displayed changes in material and "well defined edges" (Hadavi et al., 2015, p. 9). People also preferred seating that offered opportunity not only for alone time but for socializing, indicating that people prefer spaces with a broad range of uses (Hadavi et al., 2015).

Virtue and Building Capacities

Biodiversity and green infrastructure's relationship to psychological wellbeing has mostly been discussed in terms of hedonic wellbeing (subjective pleasure) and the physical and mental activities they encourage. Studies also show that biodiversity and green infrastructure contribute to eudemonic wellbeing, which encompasses the entirety of the person's functioning and includes a moral element (Korpela et al., 2017). Virtue, in this context, refers to the proper functioning of reason regarding what is and is not acceptable behavior as well as the will's adherence to these prescriptions (Aristotle, 2013). In a study investigating the relationship between views of nature and self-discipline, researchers noted the content of "views from the window" accessible to children in a public housing apartment (Taylor et al., 2002, p. 41). The children performed tests measuring "impulse control" and the capacity for "delayed gratification" (Taylor et al., 2002, p. 57). The researchers assumed that the "mental mechanism" behind the virtue of self-discipline is the same one underlying "directed attention" (Taylor et al., 2002, p. 51). Hence, when someone suffers from directed attention fatigue, their capacity for self-discipline may also be diminished (Taylor et al., 2002). The tests show that girls with views of natural scenery performed better on impulse control and delayed

gratification (Taylor et al., 2002). Boys mostly spent time away from home playing, so the effects of viewing natural scenery proved inconclusive but other studies have shown that the environment they spend the most time in affects their functioning (Taylor et al., 2002). Drawing on this study, Stephen Kaplan writes, "the decline of directed attention leads to less responsible and less constructive behaviors on the part of the individual as well as to social and interpersonal difficulties" (Kaplan, 2004a, p. 229). Obtaining virtue may not be merely a matter of internalizing moral advice but maintaining a healthy mind (Kaplan, 2004a). Patients at a hospital, primarily psychiatric patients, may arrive feeling powerless over their behavior and thoughts. Natural environments, especially the forest, may provide patients the mental respite needed to help them regain the confidence and energy to practice the coping skills often taught at psychiatric inpatient programs.

Biodiversity and Gardens in Hospital Settings

In the broad sense, a restorative environment is any kind of environment that facilitates stress reduction and attention restoration. Examples include forests, backyards, and healing gardens. The distinctions between these restorative environments include their contexts and specific purpose. The characteristics of a backyard garden, meant to serve a specific household, would not necessarily facilitate healing in an acute care hospital. A healing garden is more appropriate. Defining a healing garden and describing its core features helps the designer to understand how to effectively integrate biodiversity and green infrastructure. Subvarieties of healing gardens include gardens designed for Alzheimer's patients and those that utilize horticultural therapy. For the purposes of this research, the term "healing garden" is used in the general sense to refer to "a variety of garden features that have in common a consistent tendency to foster restoration from

stress and have other positive influences on patients, visitors, and staff" (Ulrich, 1999, p. 48). It ought to contain vegetation and water as well as produce measurable outcomes such as reduction of staff burnout, lower stress for patients and staff (Ulrich, 1999). Any garden that does not accomplish this is not a healing garden.

According to Ulrich's theory of supportive garden design, a healing garden should achieve four objectives, offering "a sense of control and privacy," "social support", "physical movement and exercise", and "access to nature and other positive distractions" (Ulrich, 1999, p. 53). Sense of control means a person's felt sense of their ability to direct their lives, and this sense is strengthened by privacy. To improve patient prognosis, it is helpful to encourage patients of their capacity to make decisions for their own betterment. Design considerations for fostering a sense of control include making sure the garden can be easily found, creating a variety of space with some offering privacy, and ensuring the garden can be used actively and passively. Social support refers to "perceived emotional or caring, and material or physical aid, that a person receives from others" (Ulrich, 1999, p. 58). Design for social support should utilize "natural, spatially enclosed setting" for active talking and "spatially open setting" offering views for "passive activities" such as admiring the scenery (Ulrich, 1999, p. 61). The need to encourage movement should be self-evident, as exercise reduces stress and even depression. Access to nature and positive distractions harkens back to Ulrich's SRT and simply means any "environmental feature…that promotes an improved emotional state in the perceiver" and fosters physiological renewal via stress reduction (Ulrich, 1999, p. 64).

Literature suggests that gardens in acute care hospitals can appropriately utilize biodiversity/GI through planting design. In their book *Healing Gardens*, Clare Cooper

Marcus and Marni Barnes describe several typologies of outdoor healthcare spaces (Cooper Marcus & Barnes, 1999). Two garden typologies relevant to my design are present in Medstar Montgomery Medical Center. These include the "tucked away garden" and the "front entrance garden" (Cooper Marcus & Barnes, 1999, pp. 141 and 198). The "tucked away garden" is rare in medical settings and includes a "space set apart from the buildings" (Cooper Marcus & Barnes, 1999, p. 198). This area is appropriate for a garden that fosters health and wellbeing if no other space is available; it can be utilized more often if it is "advertised" and if walking distance is realistic (Cooper Marcus & Barnes, 1999, p. 198). Due to its distance from the hospital buildings and adjacency to the woods, the Covid Memorial Garden fits this typology. The advantages of a tucked away garden include an efficient use of "leftover space" that motivates users to exercise by walking to it (Marcus, 1999, p. 199). If located near a forest edge or other natural features, native plants that thrive along the edge can be used in conjunction with constructed elements to create a hybrid experience of wilderness and tamed garden. The woodland adjacent to the tucked away garden can contain a natural surface trail. The advantages of this trail include providing fascinating plants and animals to distract patients and staff, a means of exercise, and a way of educating the public as well as users of the hospital. Planting design should provide seasonal color, and trees should be spaced apart to broaden views. Undesirable, invasive trees and shrubs should be removed or thinned, which would likely be met with little controversy. Increased light allows evergreens to be planted, extending the restorative effects of the woodland into the winter. Formal plantings should be numerous and various but should not overwhelm views with too much detail. Plants should be chosen that attract butterflies,

hummingbirds, and other birds. Plants that provide sensory stimulation such as swaying leaves that capture the wind, and fragrance should also be considered. Lawn should also be included as freshly mown stripes of grass are familiar, comforting scenes (Cooper Marcus & Barnes, 1999).

The front entrance garden located in front of the hospital is also a suitable place for a garden that incorporates aspects of a healing garden. This area is suitable because it is "accessible and visible" and is the first thing people see when entering the hospital (Cooper Marcus & Barnes, 1999, p. 51). With appropriate plantings, the space can provide the soft fascination required for restoration and filter the views of the parking lot and building.

Chapter 3: Methods

The mixed methods that inform my design include an online survey, a focus group, the Garden Assessment Tool for Evaluators (GATE), as well as site inventory and analysis. By using these tools, I learned how to integrate biodiversity in the proposed design for Medstar Montgomery Medical Center (MMMC).

Survey

I created an online survey via Qualtrics consisting of sixteen multiple choice questions (see Appendix). The original purpose of the survey was to gain relevant information, such as preferred wildlife, to improve the Covid Memorial Garden so it could also serve as a healing garden that includes biodiversity. The questions gathered demographic information such as the participant's role at MMMC and the hours worked per week. The survey also included questions concerning time associates/staff have to go outside, the accessibility of the Covid Memorial Garden, preference for existing outdoor spaces, and preferred/undesirable wildlife (an important subject mentioned in the literature review). The survey was launched on November 12, 2021 and closed December 28th with a total of 21 responses. The limited response count was due to the survey being distributed during the Covid pandemic, which limited the amount of time staff could spend to respond to it. Nevertheless, I learned important information from it. The entirety of the survey can be found in the appendices. For the sake of brevity, only the most relevant results are included here.

According to the data, people are not likely to visit the Covid Memorial Garden. This is due to several factors such as lack of time, feeling unsafe, and a lack of signage

leading to the garden. Regarding preferred wildlife, respondents specified colorful plants, flowers in bloom, butterflies, and birds. Regarding undesirable wildlife, people specified snakes, raccoons, bees, skunks, deer, and rodents. When asked what outdoor services would be most helpful to MMMC staff and patients, seventeen people listed "eating lunch," and twenty people listed "walking and exercising." Lastly, when asked what other outdoor spaces they visit, respondents specified the garden area by the front entrance/lobby, a gazebo by the parking garage trails near the hospital, and lake Hallowell, a nearby lake with trails.

Focus Group

To supplement the survey, I conducted a focus group with five members of MMMC's Wellness Committee, whose purpose is to "create a culture of wellbeing, both at a local and system level by developing and educating associates about wellbeing support resources and available opportunities. Additionally, the committee holds educational sessions, challenges, and activities for associates on an ongoing basis." The purpose of the focus group was to inquire about how existing outdoor spaces are used at MMMC and

Covid Memorial Garden and Dry Detention Pond
Front Entrance Garden
Property
Lake Hallowell
Picnic area
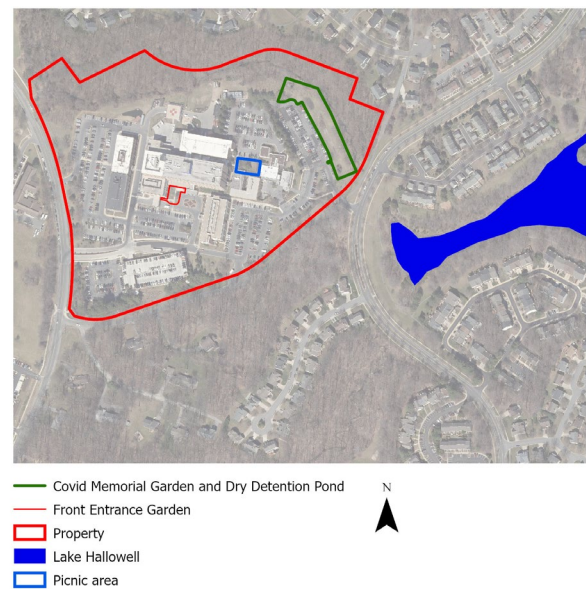
Figure 19: a map showing the most visited areas on the site according to the focus group and survey.

Figure 20: Seating near the Covid garden is in the back, obscured by dense trees.

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how to best make use of those spaces for the needs of patients, staff, and visitors while incorporating biodiversity. Like some of the participants in the survey, focus group participants said they enjoyed walking to nearby Lake Hallowell, and trails around the hospital. When asked what obstacles hinder them from accessing the Covid Memorial Garden, they specified time and a feeling of a lack of safety due to the dense canopy coverage of the site. They also mentioned the wooden

Figure 21: The seating in the Covid Memorial Garden absorbs moisture, creating unpleasant seating conditions.

seating is too wet because it is in the shade, and they desired nonporous seating material. They appreciated the ambiance of the space and the three stones around the circle. Regarding the front entrance garden, they noted the benches are well utilized but the space does not have the right ambience. The smell from the car exhaust is not pleasant and the area is dangerous because of too much traffic. The benches are sunken and unattractive. The space also lacks color. Like participants in the survey, the members of the focus group preferred birds and expressed dislike of reptiles.

Garden Assessment Tool for Evaluators

On October 22, 2021, I and two other individuals used the Garden Assessment Tool for Evaluators (Sachs, 2017) to assess the Front Entrance Garden and Covid Memorial Garden. The Garden Assessment Tool for Evaluators (see Appendix) is "an environmental assessment, or audit tool, that facilitates standardized, systematic evaluation of physical, programmatic, and policy features of gardens in general acute care hospital" (Sachs, 2017, p. 38). This garden audit tool is conducted by two or more

individuals who rank garden features according to five "domains," which include "accessibility and visibility", "sense of being away", "nature engagement", "walking activities", and "places to rest" (Sachs, 2017). Each domain is broken into subdomains which include "items" or statements that the evaluator can agree or disagree with on a 4--point Likert-type scale. Before performing the evaluation, the team determines the boundary of the garden, the primary pathway, and the main entrance, and views the area from the perspective of someone who is mobility impaired (Sachs, 2017). After examining the area and asking the question, "how well does this garden support the needs of patients, visitors, and staff?", the evaluators rate the garden's overall "restorativeness" on a scale of 1-10 ("1-4 not being restorative at all and 6-10 being completely restorative" (Sachs, 2017). After scoring all the items, and averaging them out for each participant, the five total domain scores are added together and averaged out for a total mean score. This number is then converted to a 10 point score and compared with the average score of the overall restorativeness of the garden to arrive at a more objective assessment of the garden (Sachs, 2017).

Restorativeness of the Front Entrance Garden

The mean overall restorativeness of the 0.1 acre front entrance garden is 3.66/10 compared to the total mean score of 5.78/10. For the domain of "Access and Visibility," which includes the subdomains of "visual access" and "physical access," the front entrance garden scored 2.52. It is not visible from the building and there is no signage identifying it or signage leading to it from
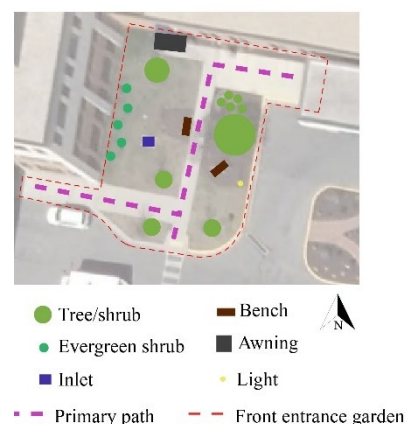
Figure 22: The Front Entrance Garden

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the building. Because the garden area is quite flat and there is a curb ramp leading to it, it

is physically accessible to a broad range of users. Under the domain "sense of 'being away'", the front entrance garden has a low score of 1.93/4. This score is consistent with the feedback of the focus group. The garden does not have a relaxed ambiance because of its adjacency to the parking lot and lack of colorful vegetation. In its current state, this is not a garden one would want to visit to relax and be at ease.

Figure 23: this poorly maintained bench is a hazard and people are at risk of splinters

Regarding "nature engagement" and "walking activities," the front entrance garden received domain scores of 2.28/4 and 2.88/4 respectively. The biggest deficiencies with "nature

engagement" include poorly maintained planting beds, unhealthy tress, and lack of "sturdy" vegetation. While the area possesses some colorful flowers (daffodils and black-eyed Susans, an unknown pink flowering shrub, and five dwarf holly bushes), the rest of the vegetation lacks any sort of wildlife value. Under "walking and activities," the only deficiencies include a lack of secondary pathways with a variety of destination routes. The garden only has a linear, rigid primary pathway meant for efficiently carrying people to lobby of the hospital. Lastly, under the domain "places to rest," which

Figure 24: This bench is sunken and of poor quality

Figure 25: This small tree has lost its attractive shape and is now an eye sore

Figure 26: This Japanese maple is sparsely branched and will likely lose more branches during snowstorms

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evaluates seating, the front entrance received a domain score of 1.93 due to a lack of tables and a lack of well-maintained furniture. Since the total mean score for all domains is 5.78 out of 10, this suggests the garden space is only partially restorative. A summary of the scores for the front entrance is listed below.

The Front Entrance Garden				
Domains and average scores				
Access and Visibility	Sense of "Being Away"	Nature Engagement	Walking and Activities	Places to Rest
2.52	1.93	2.28	2.88	1.93
Subdomains and average scores				
Visual Access to the Garden	Sense of "Being Away"	Plantings	Primary Walkway	Seating Availability and type
2.04/4	1.73/4	2.73/4	3.33/4	1.8/4
Physical Access to the Garden	Aesthetics and Maintenance	Other Natural Features	All Paved Areas	Private or Social
3/4	2.14/4	1.83/4	3.66/4	2.46/4
			Lighting, Wayfinding, and Amenities	Aesthetics and Sun
			3/4	2.46/4
			Variety and Activities	Tables
			1.66/4	1/4
Mean Overall Restorativeness				
3.66/10				
Total Mean Score				
5.78/10				

Table 1: A summary of the GATE scores for the front entrance garden

Restorativeness of the Covid Memorial Garden

The 0.1 acre Covid Memorial Garden has a mean overall restorativeness of 7.0 and a total mean score of 7.14, indicating that its actual capacity to effect restoration is matched by the first overall impression. Unlike the front entrance garden, the Covid Memorial Garden is restorative. Under the domain "accessibility and visibility," the garden

Figure 27: The Covid Memorial Garden

received a score of 1.76, the lowest score. There is no signage leading to the building and the garden is not visible from any window because it is obscured by dense foliage. There is no curb ramp leading up to the main pathway, making it impossible for those in wheelchairs to access it.

Under the domain "sense of 'being away,'" the Covid Memorial Garden received a 3.59/4. The dense canopy coverage, sheltered gazebo, and rich multisensory experiences make the garden a desirable place to visit when someone wants to be in another world. During my many site visits, I saw pileated woodpeckers, heard various bird song, and encountered interesting plants such as spicebush, whose leaves are fragrant. The only item that scored a 1.0 under the sub-domain, "aesthetics and maintenance" was the item

Figure 28: This view next to the gazebo captures the enclosed, park-like feel of the garden

Figure 29: The unsightly view of the detention ponds and parking lot on a spring da

"plants hide or soften unsightly views" because the parking lot is plainly visible from almost anywhere in the garden. There are also few plants that filter the view of the unsightly dry detention ponds located just south of the site.

The garden received a 3.05/4 under the domain "Nature Engagement." The plantings are layered and include a mixture of both deciduous and evergreen plants. The plants provide excellent fall color, turning hues of yellow and red. The plants are mostly native and provide habitat to a wide variety of animals, giving people more pleasant views of native wildlife. This is the most biodiverse area on the property. The only factors keeping this domain from receiving a perfect score include the poorly defined planting beds, the lack of a colorful herbaceous layer, and slipping hazards near the water feature, an approximately 8-foot-wide creek that runs through the woods and has seating within ten feet of its banks.

The Covid Memorial Garden has some of the strongest and the weakest features when it comes to "walking and activities", which received a mean score of 2.65/4. The primary path has a nice gentle slope, but there is no curb ramp leading up to it and it lacks seating along the steep secondary path leading to the

Figure 30: This beautiful picture reveals the lack of a curb ramp and shows the steep (uncurbed) secondary path leading to the gazebo

gazebo (about an 8% slope). This means that while the garden provides walking paths of varying difficulties, it is not ADA accessible. The American sweetgums planting along

the path, while beautiful, drop spiky fruits on the path, making walking uncomfortable. The walkway is not evenly lit, with only a randomly placed streetlight near the edge of the detention pond providing light.

For "Places to Rest", the Covid Memorial Garden scores a 3.25/4. With four picnic tables, a bench, and seating under the gazebo, the Covid Memorial Garden offers many places to sit. The amount of seating makes it easy for people to choose to either sit in a group or sit alone and enjoy the ambiance of the garden. Despite this, the quality of the seating is poor (as mentioned in the focus group). The wooden furniture (except for the seating under the gazebo) is prone to prolonged dampness after a rainstorm. Also, the area has no moveable seating. The summary of the scoring is listed to the right.

Site Inventory and analysis

In addition to the survey, focus group, and GATE, I performed site inventory and analysis according to the framework outlined by Lagro (2008). I used ArcGIS Pro and other online resources, and numerous site visits, to analyze MMMC's physical, biological,

The Covid Memorial Garden				
Domains and average scores				
Access and Visibility	Sense of "Being Away"	Nature Engagement	Walking and Activities	Places to Rest
1.76	3.59	3.05/4	2.65	3.25
Subdomains and average scores				
Visual Access to the Garden	Sense of "Being Away"	Plantings	Primary Walkway	Seating Availability and type
1.11/4	3.93/4	3.1/4	2.16/4	2.66/4
Physical Access to the Garden	Aesthetics and Maintenance	Other Natural Features	All Paved Areas	Private or Social
2.42/4	3.24/4	3/4	2.66/4	3.8/4
			Lighting, Wayfinding, and Amenities	Aesthetics and Sun
			2.75/4	3.4/4
			Variety and Activities	Tables
			3/4	3.13/4
Mean Overall Restorativeness				
7/10				
Total Mean Score				
7.14/10				

Table 2: A summary of the GATE scores for the Covid Memorial Garden

and cultural attributes Throughout this process, I discovered what kinds of wildlife and

plants are in the area, which had profound implications for the plant pallette I chose to use in the design.

Site Selection

Medstar Montgomery Medical Center in Olney, MD is approximately 27 acres. It is approximately 36 miles away from the Chesapeake Bay and ten miles away from Washington, D.C. The area is surrounded by residential neighborhoods to the north, east, and south. To the west lies the commercial district of Olney. This site caught my attention because of its adjacency to many natural features such as

Figure 31: Location Map

woodlands and water bodies such as Lake Hallowell, a "regional stormwater management pond" (Hallowell, n.d.). Opportunity exists to connect the hospital to its naturalistic context, allowing users to connect with nature more.

Topography

The topography of the site is relatively flat in the center, with steeper slopes located along its perimeter. The topography slopes downwards from the west to the east and from the north to the south, terminating in a low

Figure 32: A figure ground showing the density of the surrounding neighborhood

point which is James Creek, flowing into the nearby Lake Hallowell. The front entrance garden has a slope of 2%, making it ADA accessible. The Covid Memorial Garden and dry detention ponds are situated on steep slopes (between 8% and 33% as well as some areas being between 33% and 50%). Currently, the site is not ADA accessible and extensive regrading would have to be performed to allow those who are mobility impaired to access it.
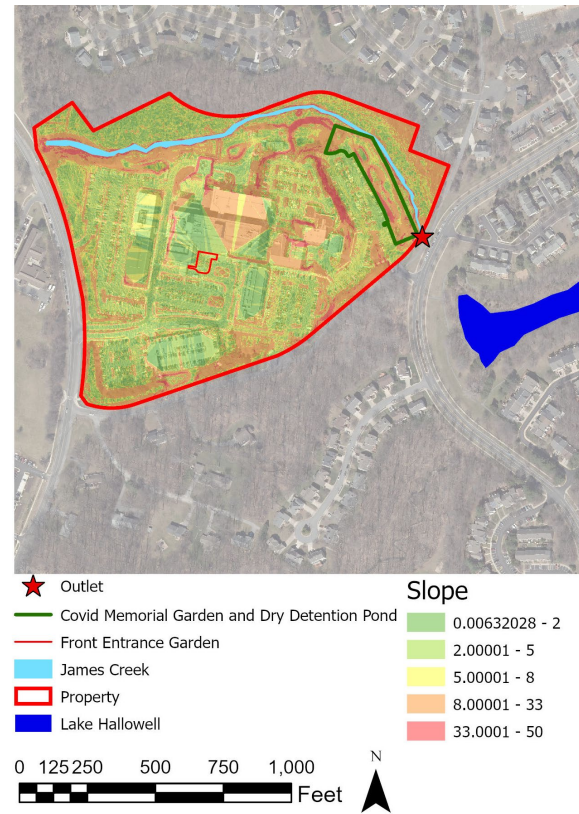
Figure 33: Slope Map showing the low point (outlet) and nearby lake.

Geology

The underlying geology on the site is mafic rock, which is associated with poorly drained soils. Other than this aspect, it contains no information relevant to design other than that these formations are associated with clay soils (*Geologic Maps of Maryland: Montgomery County*, n.d.).
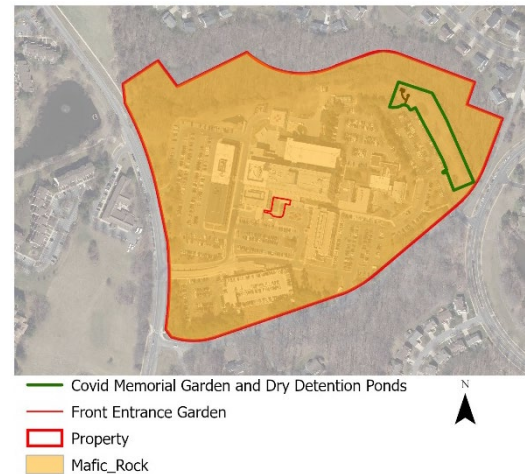
Figure 34: Geology map

Hydrology

Medstar Montgomery Medical Center is located in the 2369 acre Hawlings River Watershed. According to Montgomery County, "The Hawlings River passes through three distinct land use areas" (*Hawlings-River-Watershed-Restoration-Action-Plan.Pdf*, n.d.-a). The upper portion of the watershed has a predominantly agricultural land use. The velocity of Hawlings River increases at the middle of the watershed, contributing to bank

Figure 35: Map of the Hawlings River Watershed

erosion (*Hawlings-River-Watershed-Restoration-Action-Plan.Pdf*, n.d.-b). In the lower portion of the watershed, where MMMC is located, the soils become highly erodible and the land use becomes more residential (*Hawlings-River-Watershed-Restoration-Action-Plan.Pdf*, n.d.-b). The middle portion of the watershed contains Rachel Carson Conservation Park, which contains some "of the best stream habitat in the watershed" (*Hawlings-River-Watershed-Restoration-Action-Plan.Pdf*, n.d.-b)

A portion of the site near the dry detention ponds lies within the 100 year floodplain, restricting any kind of development (*Floodplain District Permit Process -*

Department of Permitting Services - Montgomery County, Maryland, n.d.). This makes any kind of design intervention such as sidewalks, grading, and other structures complicated because intervention would have to go through a permitting process (*Floodplain District Permit Process - Department of Permitting Services - Montgomery County, Maryland*, n.d.). This restriction makes construction of any ADA path through the floodplains difficult since concrete sidewalks are not feasible.

Water flows from the south of the site to the north and from the east to the west. The hospital has several stormwaters BMPs along its perimeter that intercept and treat the stormwater before it enters James Creek. These
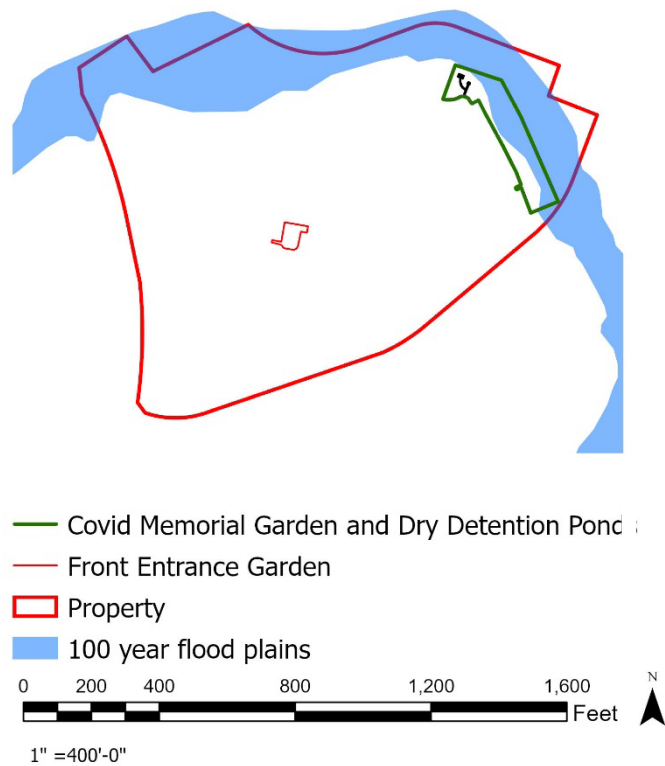
Figure 36: A map showing the proximity of the Covid Memorial Garden to the 100 year flood plain
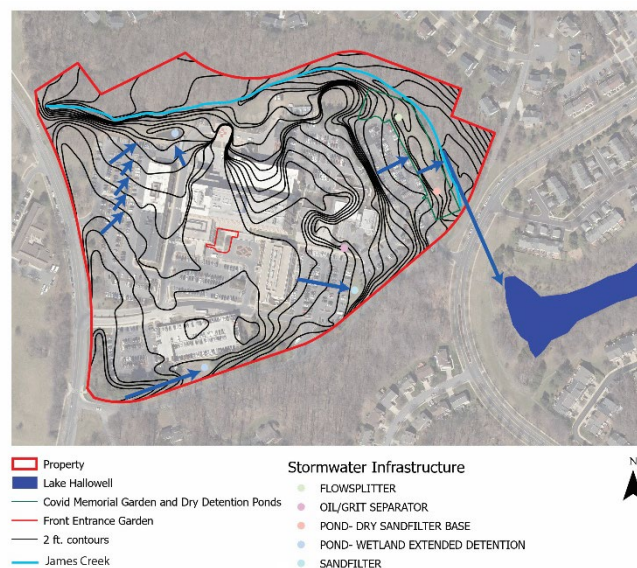
Figure 37: Water flow diagram

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include an extended detention pond, a sand filter, and a dry detention pond with a sand filter base. The dry detention pond is located to the south of the Covid Memorial Garden. According to Mark Keane, the facilities director of the hospital, Mongomery County DEP has requested that MMMC update its aging stormwater infrastructure, so opportunity exists to retrofit the dry detention pond into something that is an amenity as well as a utility.

Soils

Soils are especially important for design for two reasons: they affect what kinds of plants can grow and how fast stormwater flows off the site. MMMC contains primarily Hydrological class B soil, which is well drained and suitable for various kinds of vegetation. Due to the amount of impervious surface of the site, it is doubtful if much of the soil that is covered with impervious surfaces such as concrete and asphalt can be considered class B. The Wheaton-Urban land complex has a high water supply of 0-60 inches (amount of water the soil can hold) and a depth to the water table greater than 80 inches.

Table 38: Soil map

This means the soil is quite dry and hydrophilic vegetation would be inappropriate to put here (with some exceptions as some plants are quite adaptable where soil moisture is

53
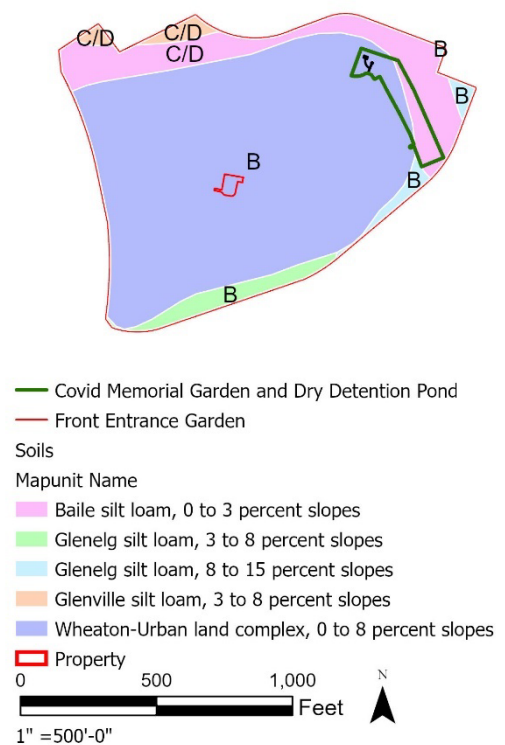
concerned). The soil of the front entrance garden and Covid Memorial Garden

corresponds to this type. A portion of the dry detention pond has baile silt loam, which is

class C/D soil and has an extremely low depth to the water table (0-6 inches). Any

vegetation planted here should be suited to wet soil. A summary of the soil types, their

acreage, and percentage can be found below.

Montgomery County, Maryland (MD031)				
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI	Hydrological Soil Group
2B	Glenelg silt loam, 3 to 8 percent slopes	1	3.80%	B
2C	Glenelg silt loam, 8 to 15 percent slopes	0.5	1.90%	B
5B	Glenville silt loam, 3 to 8 percent slopes	0.4	1.40%	C/D
6A	Baile silt loam, 0 to 3 percent slopes	4.2	15.40%	C/D
66UB	Wheaton-Urban land complex, 0 to 8 percent slopes	21	77.60%	B
Totals for Area of Interest		**27.1**	**100.00%**	

Table 3: Soils table

Climate

Olney, MD is in USDA

climate zone 7a (*Olney, Maryland*

Hardiness Zones, n.d.). The climate

is "mild, warm, and temperate"

(*Olney Climate: Average*

Temperature, Weather by Month,

Olney Weather Averages - Climate-

Data.Org, n.d.). The average

Figure 39: Walking through this stretch of sidewalk adjacent to the parking lot is not a comfortable experience during the summer.

temperature is 13.9 Celsius or 56.9 degrees Fahrenheit. It receives an annual rainfall of

45.9 inches with the highest amount of precipitation occurring in the month of May and

the lowest occurring in August (*Olney Climate: Average Temperature, Weather by*

Month, Olney Weather Averages - Climate-Data.Org, n.d.). The hottest month of the year is July which has an average temperature of 78.7 degrees Fahrenheit (*Olney Climate: Average Temperature, Weather by Month, Olney Weather Averages - Climate-Data.Org*, n.d.). Because of the high amount of asphalt on the property, this site likely has an urban heat island effect, intensifying the already intense hot temperatures of August and July. There are stretches of sidewalk and asphalt with no tree cover spanning over a hundred feet. These areas are especially in need of trees.

At the site scale, I conducted a sun/shade study on the summer and winter solstices using Sketchup Pro.

Figure 40: The sun/shade study for the front entrance garden reveals that the area receives part sun at its western end and full sun at its eastern end.

The front entrance garden receives a lot of solar radiation. Judging by the sun and shade study, it makes sense to place shaded seating at the western edge closer to the building and seating in the sun at the eastern end. Plants in this area should be able to tolerate part sun to full sun.

Figure 41: The area around the Covid Memorial Garden receives full sun along the edge of the parking lot but receives part shade near the gazebo

The Covid Memorial Garden receives part shade. The adjacent parking lot lacks tree plantings in the islands, intensifying the urban heat island effect. A simple solution

would be to plant shade trees in these areas and give pedestrians and cars a welcome respite from the sun.

Vegetation

My vegetation inventory focused within the area of the detention ponds and Covid Memorial Garden because at that time, the design did not encompass the front entrance garden. My inventory took place during the month of September during which I visited the site to catalogue native trees, shrubs, and invasive plant species using a dichotomous key and the "plant pages" from my course in woody plants. The native canopy trees consist of tulip poplars, American beeches, American sycamores, black walnuts, red maples, red oaks, American sweetgums, and elm species. These plants have high wildlife value. They provide food for birds, mammals, and caterpillars, and nectar/pollen for insects as well as providing shelter for animals (Darke & Tallamy, 2014). They produce a panoply of fall colors ranging from yellow to scarlett. These trees are an existing amenity that enhance the restorative effect of the Covid Memorial Garden.

The native understory consists of American spicebush, *vitis* (grape) species, eastern dogwoods, and poison ivy (an undesirable native species). All of these species provide food for birds. American spicebush is a host plant for the spicebush swallowtail, a beautiful native butterfly that enhances the natural aesthetic of the area (*Spicebush Swallowtail | NC State Extension Publications*, n.d.). Invasive species consist of oriental bittersweet, mile a minute vine, Japanese stiltgrass, and wineberry. These species overwhelm and strangle native vegetation and their vigorous growth gives the forest the appearance of a dense jungle, blocking light and giving it a scary and unpleasant atmosphere. The list of plants, their names, and relative abundance are listed below.

Native Canopy Species
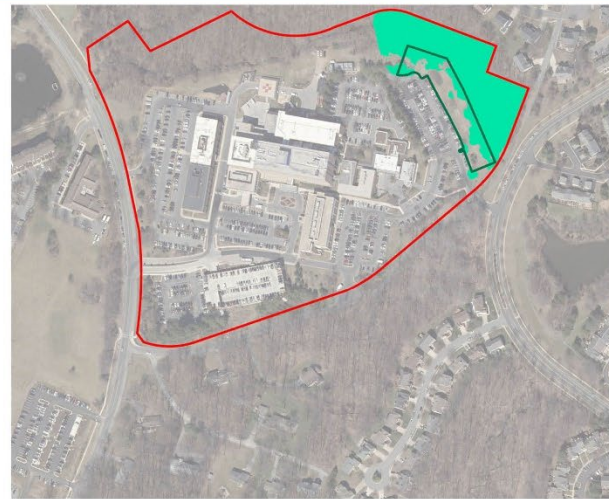
Legend
- ▭ Property
- — Covid Memorial Garden and Dry Detention Ponds
- ▮ Native Canopy Species

N

Liriodendron Tulipifera
Tulip Poplar
abundance: 20%

Fagus Grandifolia
American Beech
abundance: 15%

Acer Rubrum
Red maple
abundance: 15%

Platanus Occidentalis
American sycamore
abundance: 10%

Juglans nigra
Black walnut
abundance: 10%

Red Oaks
Red Oaks
abundance: 10%

Liquidambar styraciflua
American sweetgum
abundance: 10%

Ulmus Sp.
elm Sp.
abundance: 10%

Figure 42: A list of Native Canopy trees and their relative abundance.

Native Understory Species
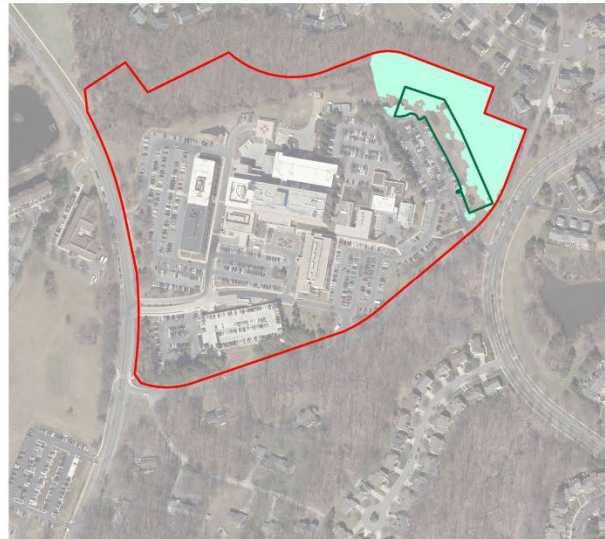
Legend
- ▭ Property
- — Covid Memorial Garden and Dry Detention Ponds
- ▨ Native Understory Species

N

Lindera benzoin

American spicebush

abundance: 50%

Toxicodendron radicans

Poison ivy

abundance: 20%

Vitis species

Vitis species

abundance: 20%

Cornus Florida

Eastern dogwood

abundance: 10%

Figure 43: A list of native understory species and their relative abundance

Nonnative Invasive Species
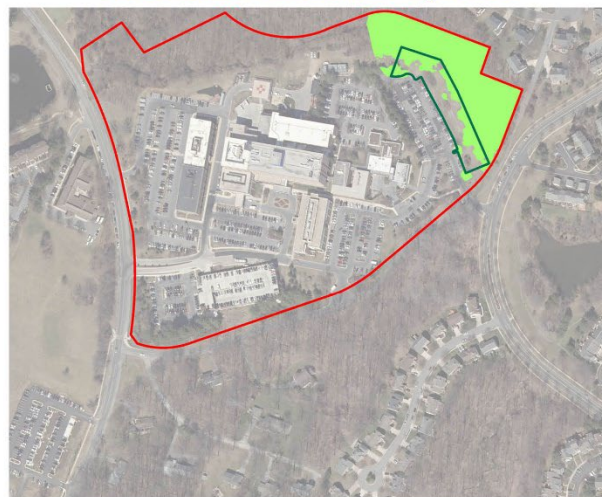
Legend
- ⬜ Property
- — Covid Memorial Garden and Dry Detention Ponds
- 🟩 Nonnative Invasive Species

N

Celastrus orbiculatus

Oriental bittersweer

abundance: 10%

Persicaria perfoliata

Mile-a-minute vine

abundance: 10%

Microstegium vimineum

Japanese stiltgrass

abundance: 60&

Rubus phoenicolasius

Wineberry

abundance: 20%

Figure 44: A list of nonnative invasive species and their relative abundance.

Wildlife

Using a combination of research and ArcGIS Pro, I mapped hubs, corridors, and existing parks to discover the most biodiverse areas and their approximate distance from MMMC. The site is approximately four miles from Rachel Carson Conservation Park and one mile from Hawlings River Stream Valley Park, two biodiverse areas according to Montgomery County. It is connected to these

Figure 45: Biodiversity map

areas through the 100-year floodplain. Rachel Carson Conservation park is home to many valuable butterfly and bird species that would be welcome to visitors at MMMC (*Montgomery Planning: Master Plans - Olney & Vicinity Environmental Resources Inventory*, n.d.). The area is home to bluebirds, great blue herons, scarlett tanagers, and American gold finches. Butterfly species include eastern tiger swallowtails, spice bush swallowtails, and eastern tailed blues. The opportunity exists to strengthen the connection between MMMC and Rachel Carson Conservation Park by including plants that attract some of these desireble birds and butterflies. For a more comprehensive list of species that live in Rachel Carson Conservation Park, see Appencix.

History

MMMC was founded in
1918 by Dr. Jacob Wheeler Bird,
a graduate of the University of
Maryland, during the flu of 1918
and admitted its first five patients
during a blizzard (*Our Hospital |
MedStar Montgomery Medical
Center | MedStar Health*, n.d.-b).
It was the first nonsectarian
hospital in Montgomery County
(*M; 23-122.Pdf*, n.d.). Its original
location was a house Dr. Bird
rented called Wrenwood (*M; 23-
121.Pdf*, n.d.). Dr. Bird "served

Montgomery General Hospital.   Dedication of the original building, 1919.
(Photo, courtesy Mary Ellen Hines)

Figure 46: a picture of the dedication of Montgomery General Hospital. Image from https://mht.maryland.gov/

THE HOSPITAL IN 1920

Figure 47: The completed Wrenwood house. Image from https://mht.maryland.gov/

his community through work with organizations such as the Social Service League, the

Juvenile Court, and the Maryland State Welfare Department. He was for many years a

member of the Maryland State Board of Health" (*M; 23-121.Pdf*, n.d.). Dr. Bird served

the residents of Montgomery county for over fifty years until his death in a car accident

in 1959 (*M; 23-121.Pdf*, n.d.). In 1977, the old hospital was demolished and replaced by

the more modern present day facility (*M; 23-121.Pdf*, n.d.). With over 100 years of

history serving the community during two pandemics, the flu of 1918 and the Covid

pandemic, the hospital has an opportunity to highlight the legacy of Dr. Bird.

Figure 48: A photo of MMMC under construction during 1970. Photo courtesy of Stewart Bros Inc

Past and Current Land Use

According to an interview with Facilities Director Mark Keane, the site of Medstar Montgomery General Hospital, the property that became MMMC, has an originally agricultural land use. This is confirmed by historic imagery showing the property's

Figure 49: Aerial imagery from 1951. Image credit: https://gis3.montgomerycountymd.gov/historical_images/

development from 1951 to the present day. The 1951 image reveals a pastoral setting dotted with trees (*Historical Images in Montgomery County, MD*, n.d.). The nearby James Creek transitions from a predominantly grassy bank to the forested area that it is today. This series of photographs tells the story of the transition from a more rural, pastoral America to the modern, more biodiverse environment of today. The monocultures of grass and crops are replaced with forests and more diverse plants in addition to the expanses of asphalt. An opportunity exists to

Figure 50: Historical imagery from 1970 during the hospital's construction. Image credit from: https://gis3.montgomerycountymd.gov/historical_images/

Figure 51: Historical imagery showing the nearly finished hospital in 1979. Image credit: https://gis3.montgomerycountymd.gov/historical_images/

continue this theme of ecological transition by incorporating more biodiversity in the hospital campus

Currently, the site area is zoned as R-2 (residential) but it would be more accurate to characterize it as institutional land use since it is the site of an acute care hospital. According to the Montgomery County Planning Department "The RE-2 Zone has for decades allowed residential homes in the County's agricultural or rural areas"

(*RE2_001.Pdf*, n.d.). Given the site's proximity to natural areas such as Rachel Carson Conservation Park, this designation makes sense.

Neighborhood Character and demographics

The town of Olney has a population of 35, 820 (*U.S. Census Bureau QuickFacts*, n.d.). The area is 65.7% white and has a median income of $149, 555, making it an upper middle-class area. The neighborhood suburban

Figure 52: A typical residence less than one mile from the hospital. Image credit: Google earth

surrounding the hospital is made up of two-story buildings that are of little architectural significance and might be described as "cookie cutter."

Circulation

Pedestrian circulation is problematic on the MMMC property as pedestrians are forced to walk through parking lots with no shelter from oncoming traffic. I walked to the Covid Memorial Garden from both the front and rear entrances of the hospital and was forced to walk along the parking lots as sidewalks terminated in dead ends. The opportunity exists to connect these "paths to nowhere" to sensible destinations, making the environment more legible, less confusing, and safer. The hospital has many existing garden spaces that are underutilized because of a lack of crosswalks and other clear means of accessing these spaces. These gardens include the Healing Garden, the Smith Garden, and the Roger Carrol Garden. Since it takes (at least) five minutes to walk to the

Covid Memorial Garden from the front entrance and about three minutes from the rear

entrance, it is important to give people other garden spaces where they can relax because

they may not have the time to walk any farther
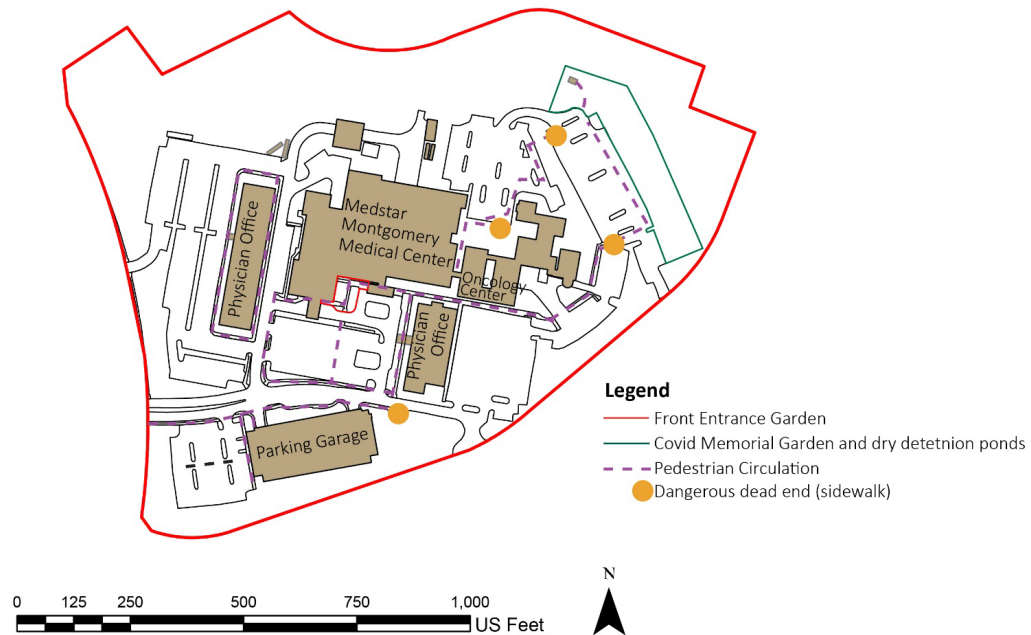
Figure 53: Circulation map showing areas that are dangerous for pedestrians.

Chapter 4: Healing with Nature at Medstar Montgomery Medical Center

Design Program

Vision				
Promote health and well-being for patients, staff, and visitors of Medstar Montgomery General Medical Center through biodiversity and green infrastructure				
Goals				
Promote walking activities to foster health and well being	Improve "accessibility and visibility"	Enhance users' interaction with nature	Give people an experience of being in another world	Provide respite and refuge
Use biodiversity to elicit feelings of fascination and curiosity to encourage exploration (Stigsdotter 2011 and Kaplan and Kaplan, 1995)	Make the space easy to navigate and increase its "legibility" (Kaplan and Kaplan, 1989)	foster a sense of "richness of species" (Stigsdotter, 2011) by incorporating biodiversity	Distract people from every day cares by providing a sense of "being away" via biodiversity (Kaplan and Kaplan 1995)	Provide respite by offering a sense of "control and privacy" and "social support" (Ulrich, 1999)
Program				
Include a variety of paths and destinations with diverse vegetation that encourage people to wander.	Include wayfinding, safe routes, and accessible entrances to the garden spaces.	Provide colorful plantings with seasonal interest that attracts birds and butterflies	Filter the view of parking lots and cars to make people feel more relaxed.	Provide shelter as well as private and social seating in biodiverse naturalistic environments, allowing people to choose their setting.

Table 4: Design Program

The vision for the design at Medstar Montgomery Medical Center is to promote the health and well-being for patients, staff, and visitors at Medstar Montgomery Medical Center. After completing the literature review, site inventory and analysis, the survey, focus group, and Garden Assessment Tool for Evaluators, I developed a set of goals to guide my design for Medstar Montgomery Medical Center (see the table above). These goals include encouraging walking, improving the "accessibility and visibility" of the Covid Memorial Garden, enhancing users' interaction with nature, giving people the experience of being in another world, and providing respite and refuge. Encouraging walking activities relates to the "building capacities" section of my literature review and was mentioned as a desirable activity in both the survey and focus group. Including biodiversity in the form of various plants, birds and butterflies encourages people to wander and investigate the living things that hold their fascination. Improving the accessibility and visibility of existing garden spaces (and proposed) relates to Kaplan and Kaplan's concept of legibility, the GATE, and feedback received from the survey and focus group. An area may be rich in species that elicit fascination but this is uselss if people cannot access it. Currently, few people have time to visit the Covid Memorial Garden. It is not accessible via curb ramp and the dense foliage obscures it, making it appear frightening to some. Enhancing user's interaction with nature relates to Stiggsdotter's concept of perceived sensory dimensions, especially richness in species. According to feedback from the focus group and survey, people enjoy seeing colorful flower, birds, and butterflies. The members of the focus group think the front entrance garden lacks color and the right ambiance because of its proximity to the parking lot. Giving people a sense of being in another world is strongly connected with the above

goal of enhancing peoples' interaction with nature. Currently, users are surrounded by asphalt and concrete. The existing garden spaces on the campus are disconnected, not highly visible, and inaccessible. Sidewalks terminate in dead ends, forcing people to walk across parking lots to get where they need to go. In other words, people may feel confined to the drab. existing outdoor setting in which they find themselves. Filtering these unpleasant views with biodiverse vegetation will make their experience more comfortable and restorative. Lastly, the design should provide opportunities for respite and refuge, a key part of psychological restoration. Outdoor seating opportunities in naturalistic, biodiverse settings should be available to people as they navigate the campus and places of enclosure should be provided.

Creating the Journey

To encourage people to access the Covid Memorial Garden, I designed a loop that connects the garden to the front and rear entrance of the main building. I also expanded the area of the .1-acre Covid Memorial Garden into a larger 1 acre garden space named the "The Jacob Wheeler Bird Memorial Garden". I chose the name to connect to the hospital's history and relate the Covid Memorial Garden to the hospital's founding during the 1918 pandemic. Many of the garden spaces along the journey include the word "healer" in their names in honor of the statue called "the healer" that currently resides in the Roger Carrol Memorial Garden. By including biodiversity in each of these named spaces, I reinforce the connection between healing and biodiversity. In each proposed space, I increase biodiversity to provide restorative fascination and soften the views of concrete and asphalt. It is my hope that users will be prompted to travel through or part way through the loop, motivated by various experiences of plants and desirable wildlife

along the way. The advantage of this loop is that no one is forced to travel to one destination to experience the healing benefits of nature. People have the choice to experience a beautiful garden right outside the front entrance or they can make the journey to the Jacob Wheeler Bird Memorial garden

Figure 54: Site plan for Medstar Montgomery Medical Center showing the destinations people can access along their journey to the Jacob Wheeler Bird Memorial Garden from the front and back entrance

From the front entrance, the user travels from the "Healer's path healing garden" to the renovated "Roger Carrol Memorial Garden", then walks through "serenity way" which leads to an existing healing garden with a pond. The user then makes her way through "Healer's passage" an island formed by merging two parking lots into an exsting island, broadening it and making it suitable for helping pedestrians to navigate the parking lot. Finally, the user makes her way along a short sidewalk along the parking lot before embarking on the elevated structure above the detention pond, which is screened

from the parking lot by trees, grasses, and flowers.. In many of the destination, I use a curvilinear design motif (where appropriate) for the pedestrian walkways to capture a sense of mystery and fascination as well as to reflect the meandering James Creek, which runs through the property from the northeast.

From the rear entrance, the user makes her way past an existing picnic area and through a linear space named "spruce walk", which is named for the existing Norway Spruce along its western side. In order to make the area more comfortable, I converyt 6 exisitng parking lots into a planted space with a curvilinear sidewalk. I also take five feet from the existing 20 foot wide drive and turn it into a planted buffer between pedestrians and the road. A sidewalk runs parallel to th planted space and leads her to the crosswalk that lead to the Jacob Wheeler Bird Memorial Garden. In the following sections, I zoom in on each of the proposed destinations and provide a biodiversity legend. The plant legend lists all the proposed plants and the wildlife they attract.

Healer's path healing garden

I increase biodiversity in this area by attracting seed desireable birds and butterflies via a mostly native plant pallet with seasonal color that provides restorative fascination. Fragrant clethra alnifolia 'summersweet' surrounds a bench facing a planted area. Its fragrance should be able to counter the smell of exhaust from the vehicles. 6 dwarf hollies and a foster holly provide interest

Figure 55: An Aerial view of the Charlotte Garden

throughout the winter as well as food for birds. Two 'Autumn Brilliance' service berries

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and onr flowering dogwood also attract birds in the spring and fall respectively. Both have rich red fall color that complements the yellow fall color of the clethra. Mindful that too much biodiversity may be overwhelming for some, I include a lawn space just to south of the gazebo,

Figure 56: An aerial view of the Charlotte Garden, which inspired the curvilinear structure of healing garden

an important feature to include given the hospital's suburban context.

For the Healer's Path Healing Garden, I was inspired by the mosaic pattern of the Charlotte Garden in Copenhagen, designed by SWA, an international landscape architecture, planning, and urban design firm. Its irregular curvilinear shape inspired me to break the rigid linear primary path and create a more organic path. The eastern portion of the garden serves as a waiting area for staff, patients, and visitors as they wait for someone to pick them up. For that reason, I made this
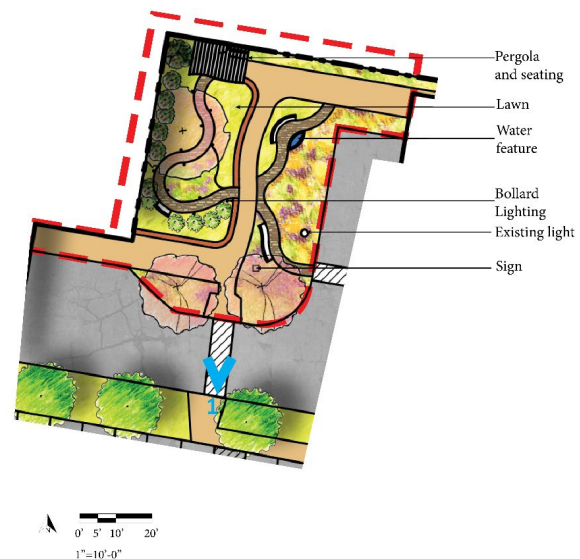
Figure 57: site plan Healer's Path Healing Garden.

area more open so nothing would obstruct the view of people looking for a ride. The curved bench on the southern portion allows people to sit in the shade while the bench by the water feature allows people to sit in the sun. The water feature is a quiet fountain with

minimal splash so the sound it produces is like the quiet murmur of a creek. The western portion of the garden is surrounded by an 18-inch stone wall that provides seating as well as enclosure. A three-foot-wide secondary path connects the western portion with the eastern portion of the garden, encouraging exploration and movement. A wayfinding sign is also included to guide people to the Jacob Wheeler Bird Memorial Garden.

Biodiversity legend

	Scientific Name *Amelenchier x Grandiflora* 'Autumn Brilliance'	Common name 'Autumn Brilliance' service berry	Desireable Wildlife Song birds.	Northern Cardinal	Cedar waxwing	American robin	Eastern bluebird	American goldfinch	Carolina chickadee	Gray catbird
	Scientific Name *Cornus Florida 'Gulf Pink'*	Common name Flowering dogwood 'Gulf Pink'	Desireable wildlife various song birds	American robin	Eastern bluebird	Gray catbird	Scarlet tanager	American goldfinch	Carolina chickadee	Tufted titmouse
	Scientific Name *Ilex cornuta 'Burfordii Nana'*	Common name 'Dwarf Burford' Holly	Desireable wildlife Various song birds	Carolina chickadee	American robin	Gray catbird	Eastern bluebird	Northern Cardinal	Cedar waxwing	Tufted titmouse
	Scientific Name *Clethra alnifolia 'hummingbird'*	Common name 'hummingbird' summersweet	Desireable wildlife Various butterflies, ruby throated hummingbirds	Clouded sulfur	Great spangled fritillary	Eastern tailed blue	Monarch	Tiger swallowtail	Spicebush swallowtail	ruby throated hummingbird
	Scientific Name *Ilex x attenuata fosteriori*	Common name Foster's holly	Desireable Wildlife Various song birds	Carolina chickadee	American robin	Gray catbird	Tufted titmouse	Eastern bluebird	Northern Cardinal	Cedar waxwing
	Scientific Name *Asclepias tuberosa Echinacea pupurea Rudbeckia hirta*	Common name Butterfly weed Purple coneflower Black eyed susan	Desireable Wildlife various song birds and butterflies	Northern Cardinal	American goldfinch	Carolina chickadee	Great spangled fritillary	Clouded sulfur	Eastern tailed blue	Monarch
	Scientific Name *Carex pennsylvanica Phlox divaricata*	Common name Pennsylvanis sedge Woodland phlox	Desireable Wildlife Various butterflies	Clouded sulfur	Great spangled fritillary	Tiger swallowtail	Spicebush swallowtail	Eastern tailed blue	Pearl crescent	Monarch

Table 5: Biodiversity legend for Healer's Path Healing Garden

Figure 56: Perspective of Healer's Path Healing Garden

Roger Carrol Memorial Garden

The Roger Carrol Memorial Garden was given by the Landscape Contractors association and consists of a statue by Philip Ratner called "The Healer" and a pathway of brick donated by loved ones. I propose rearranging the brick path to allow for the placement of two benches and to clearly direct people to the next phase of the
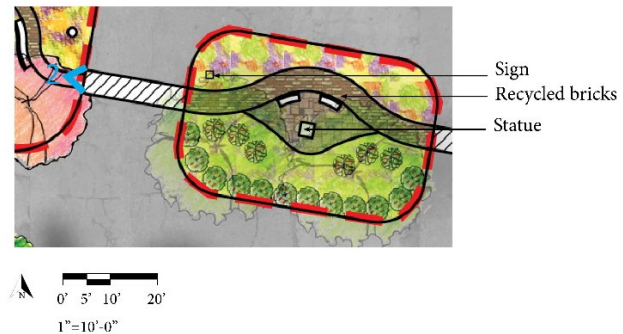
Figure 58: Site plan of Roger Carrol Memorial Garden

journey, "Serenity Way". I also propose an open space made of flagstone where the statue can rest, unobscured by vegetation and clearly visible from the front entrance and to onlookers. Currently, there is no curb ramp leading to the garden, no place to sit, and the vegetation has little wildlife value. I increase biodiversity in this garden by removing the nonnatives and including a diverse meadow planting on the north end. The common blue violet, which I include, is a host plant for the great spangled fritillary, a native butterfly of Rachel Conservation Park. The dwarf Burford holly provides food for birds into the winter. The butterflies, birds, and plants will provide soft fascination and people will find rest in the shade of the river birch. In addition to supporting desirable native wildlife, the plant pallet has seasonal interest, extending the areas restorative effects into the winter. The oakleaf hydrangea and rive birch have beautiful, exfoliating bark. The little bluestem, which is located north of statue, turns a rich bronze color during the winter and fall. The heartleaf foamflower also turns shades of red and magenta during the fall and winter.

Biodiversity Legend

	Scientific Name	Common name	Desired Wildlife					
	Betula nigra 'duraheat'	'duraheat' river birch	woodpeckers and song birds	Pileated woodpeckers	Carolina Chickadee	Northern cardinal	American goldfinch	Tufted titmouse	White breasted nuthatch
	Hydrangea quercifolia	Oakleaf hydrangea	Various butterflies and song birds	Pearl crescent	Spicebush swallowtail	Tiger swallowtail	Northern cardinal	American goldfinch	Carolina Chickadee
	Ilex cornuta 'Burfordii Nana'	'Dwarf Burford' Holly	Song birds	Carolina Chickadee	Cedar waxwing	Gray catbird	Tufted titmouse	American robin	Eastern bluebird
	Monarda didyma Liatris spicata Schizacyrium scoparium 'Standing ovation' Rudbeckia hirta	Scarlett beebalm Dense blazing star 'Standing ovation' little bluestem Black eyed susan	Song birds, butterflies, and hummingbirds	Northern cardinal	American goldfinch	Carolina Chickadee	Great spangled fritillary	Spicebush swallowtail	Tiger swallowtail
	Tiarella cordifolia Viola sororia	Heartlead foamflower Common blue violet	Great spangled Fritillary		Unknown	Unknown	Unknown	Unknown	Unknown

Table 6: Biodiversity Legend for the Roger Carrol Memorial Garden

Figure 59: Perspective of the Roger Carroll Memorial Garden59

Serenity Way

Serenity Way includes a long, linear sidewalk next to the oncology building existing sidewalk by the oncology building. I increase biodiversity by replacing the monoculture of grass by the sidewalk with little blue stem and black eyed Susan. I also propose planting 'winter king' green hawthorn trees along the path. These trees grow to 25-35 feet tall and wide. They have a pleasing horizontal branching structure that would provide an attractive, sheltering canopy for benches. The branches are laden with berries during the winter and white flowers in the spring,

Serenity way

Figure 60: Site plan of Serenity Way

Figure 61: A view of the Healing Garden where Serenity Way leads

providing seasonal beauty and wildlife value. I also propose an underplanting of New Jersey tea shrubs underneath one of the hawthorns. This low growing shrub that only reaches a height of 4 feet is adapted to sun and part shade. Its summer blooms attract many kinds of pollinators. The addition of these planting replaces the flat expanse of concrete and stimulate soft fascination with birdsong and grass blowing in the wind. I

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also propose a 3-foot-wide sidewalk that leads to the existing healing garden that consists of a serene pond surrounded by plantings (hence the name, serenity way).

Biodiversity legend

	Scientific Name	Common name	Desired Wildlife					
	Scientific Name *Craetaegus viridis* 'winter king'	'Winter King' green hawthorn	Song birds	Cedar waxwing	American robin	Gray catbird	Northern cardinal	Brown thrasher
	Scientific Name *Ceanothus Americanus*	New Jersey Tea	Desired Wildlife Butterflies and humming birds	Pearl crescent	Great spangled fritillary	Tiger swallowtail	Spicebush swallowtail	Ruby throated humming bird
	Scientific Name *Echinacea Purpurea Rudbeckia hirta*	Purple coneflower Black eyed susan	Desired Wildlife Song birds and butterflies	White breasted nuthatch	American goldfinch	Northern cardinal	Tiger swallowtail	Spicebush swallowtail
	Scientific Name *Schizacyrium scoparium 'Standing ovation' Rudbeckia hirta*	'Standing ovation' little bluestem Black eyed susan	Desired Wildlife Song birds and butterflies	White breasted nuthatch	American goldfinch	Northern cardinal	Tiger swallowtail	Spicebush swallowtail

Table 7: Biodiversity legend for Serenity Way

Figure 62: Perspective of Serenity Way

Healer's Passage

Before the pedestrian arrives at the Jacob Wheeler Bird Memorial Garden, she passes through a proposed planted parking island with a 5-foot sidewalk bordered by plantings . I increase biodiversity in this area by replacing the asphalt with 'hummingbird summersweet,
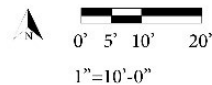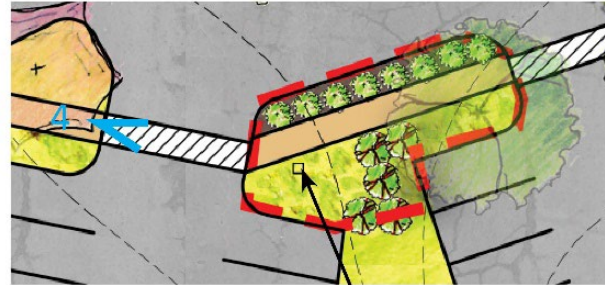
Healer's Passage

Figure 63: Site plan of Healer's Passage

'Arctic fire' red twig dogwood, a 'duraheat' river birch, 'standing ovation' little bluestem, and thread leaf coreopsis. This space serves as a buffer between pedestrians and the road, creating a space where people can safely walk where no such space currently exists. I chose Clethra alnifolia 'hummingbird' once again because of its compact habit. The planted is space is only 4.5' wide, which makes larger shrubs unsuitable as their foliage would cover the sidewalk. I chose *Cornus sericea* 'arctic fire', *Shcizacyrium scoparium* 'standing ovation', and *Coreopsis verticillate* 'zagreb' for the same reason. They are also cultivars that either do not droop or are compact enough that they will not overcrowd the space. While this area is merely a through space, it is a fitting prelude to the Jacob Wheeler Bird Memorial Garden. Its presence makes the space more legible, giving people a clear sense of direction, which the space currently lacks as the sidewalk abruptly ends. All the plants possess seasonal interest in the form of fall color.

Biodiversity legend

	Scientific Name	Common name	Desired Wildlife				
	Scientific Name *Betula Nigra 'Duraheat'*	Common name 'Duraheat' River Birch	Desired Wildlife Wood peckers and song birds	Pileated wood pecker	Northern cardinal	Carolina chickadee	American goldfinch
	Scientific Name *Clethra alnifolia 'hummingbird'*	Common name 'hummingbird' Summersweet	Desired Wildlife Butterflies and hummingbirds	Eastern tiger swallowtail	Spicebush swallowtail	Great spangled fritillary	Ruby throated hummingbird
	Scientific Name *Cornus Sericea* 'farrow' ARCTIC FIRE	Common name ARCTIC FIRE redtwig dogwood	Desired Wildlife Song birds	Eastern bluebird	American goldfinch	Northern cardinal	Carolina Chickadee
	Scientific Name *Schizacyrium scoparium 'Standing ovation' Coreopsis verticlliata 'zagreb'*	Common name 'Standing ovation' little bluestem 'zagreb' Threadlead coreopsis	Desired Wildlife Song birds and butterflies	American goldfinch	Northern cardinal	Eastern tiger swallowtail	Spicebush swallowtail

Table 8: The biodiversity legend for Healer's Passage

Figure 64: Perspective of Healer's Passage

The Jacob Wheeler Bird Memorial Garden

Once the traveler walks through Healer's passage, she arrives at the threshold of the 1-acre Jacob Wheeler Bird Memorial Garden. I increase Biodiversity in this area by planting the barren dry detention pond with vegetation suitable for bioretention. Various evergreens such as 'Maryland dwarf' American holly, dwarf Burford holly provide seasonal interest well into the winter and provide food for birds. The three-foot-high elevated structure over the dry pond and the winding path to the north provide a restorative, nature immersive experience without being scary. A railing keeps those in wheelchairs safe and people from

Figure 65 Conceptual site plan of the Naval Cemetery Memorial Landscape

Figure 66: A view of the boardwalk at the Naval Cemetery Memorial Landscape

falling. The dry detention pond, which allows a few inches of ponding, is robustly planted with vegetation suitable for bioretention. The lower area of the pond is planted with blue flag iris, 'Shenandoah' Virginia switchgrass, black eyed Susan, and swamp milkweed. The side slopes are planted with 'Maryland dwarf' American holly, 'Shenandoah' Virginia switchgrass, and purple coneflower. These plants are suitable for bioretention at their respective locations according to Montgomery County Department of

the Environment (*PlantingDesign4Bioretention-RainGardens.Pdf*, n.d.). The curvilinear shape of the 322-foot-long elevated structure was inspired by the boardwalk over the Naval Cemetery Memorial Garden. A bulge on the northern end of the boardwalk makes room for a 10-foot-long bench where people can rest along the journey. After crossing the

Jacob Wheeler Bird Memorial Garden

Figure 67: Site plan of the Jacob Wheeler Bird Memorial Garden

boardwalk, the traveler can either maker her way to the fire pit surrounded by Adirondack chairs, take the path leading to the woods, or make her way to the iconic 10-foot-wide circle surrounded by three rocks that is part of the existing Covid Memorial Garden. After spending time reading the plaques and contemplating the role the hospital has played during the pandemic, she can either cross the parking lot and go up the existing stairs to the rear entrance or continue northwest where the formerly steep topography is graded so the proposed winding path is a more comfortable 6.6% slope. 10' by 5' paved resting areas are spaced 20 feet apart. Each space contains two large rocks for seating thar echo the aesthetic of the three rocks surrounding the existing Covid Memorial Garden. The Jacob Wheeler Bird Memorial Garden is a place where people can truly experience being away from their worries in a restorative, naturalistic

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environment. Instead of looking at a barren, pit engineered for stormwater management, users experience a journey over a richly planted habitat that is more than just a piece of green infrastructure. It part of a journey that beckons people along the path with various kinds of plants and wildlife that stir interest and fascination.

Biodiversity legend

	Scientific Name *Betula Nigra 'Duraheat'*	Common name 'Duraheat' River birch	Desired wildlife Wood peckers and song birds	Pileated wood pecker	Northern cardinal	American goldfinch	Carolina chickadee	White breasted nuthatch	Tufted titmouse
	Scientific Name *Pinus Strobus*	Common name White pine	Desired wildlife Song birds	American robin	Cedar waxwing	Brown thrasher	Northern cardinal	white breasted nuthatch	Tufted titmouse
	Scientific Name *Cornus Florida 'Gulf Pink'*	Common name 'Gulf pink' flowering dogwood	Desired wildlife Song birds	American robin	Gray catbird	Eastern bluebird	Scarlet tanager	American gold finch	Tufted titmouse
	Scientific Name *Ilex x attenuata 'fosteriori'*	Common name Foster's Holly	Desired wildlife Song birds	Carolina chickadee	American robin	Gray catbird	Eastern bluebird	Northern cardinal	Tufted titmouse
	Scientific Name Ilex cornuata 'burford*i nana*'	Common name Dwarf Burford Holly	Desired wildlife Song birds	Carolina chickadee	American robin	Gray catbird	Eastern bluebird	Northern cardinal	Tufted titmouse
	Scientific Name *Ilex Opaca 'Maryland Dwarf'*	Common name 'Maryland Dwarf' American holly	Desired wildlife Song birds	Carolina chickadee	American robin	Gray catbird	Eastern bluebird	Northern cardinal	Tufted titmouse
	Scientific Name *Hydrangea quercifolia*	Common name Oakleaf hydrangea	Desired wildlife Song birds and butterflies	Pearl crescent	Eastern tiger swallowtail	Spicebush swallowtail	Carolina chickadee	Northern cardinal	American goldfinch
	Scientific Name *Clethra alnifolia 'hummingbird'*	Common name 'hummingbird' summersweet	Desired wildlife butterflies and hummingbirds	Clouded sulphur	Pearl crescent	Eastern tiger swallowtail	Spicebush swallowtail	Great spangled fritillary	Ruby throated hummingbird
	Scientific Name *Echinacea purpurea Asclepias tuberosa Panicum virgatum 'Shenandoah"*	Common name Purple coneflower Butterfly weed 'Shenandoah' Virginia switchgrass	Desired wildlife Song birds and butterflies	Spicebush swallowtail	Eastern tiger swallowtail	Pearl crescent	Great spangled fritillary	Monarch	American goldfinch
	Scientific Name *Carex pennsylvanica Phlox divaricata*	Common name Pennsylvania sedge Woodland phlox	Desired wildlife Various butterflies	Eastern tailed blue	Clouded sulphur	Eastern tiger swallowtail	Spicebush swallowtail	Great spangled fritillary	Pearl crescent
	Scientific Name *Iris versicolor Panicum virgatum 'Shenandoah' Asclepias incarnata Rudbeckia hirta*	Common name Blueflag iris 'Shenandoah' Virginia switchgrass Swamp milkweed Black eyed Susan	Desired wildlife Song birds and butterflies	Monarch	Eastern tiger swallowtail	Eastern tailed blue	Spicebush swallowtail	Great spangled fritillary	American goldfinch

Table 9: Biodiversity Legend for the Jacob Wheeler Bird Memorial Garden

Figure 68: Perspective of the entrance to the Jacob Wheeler Bird Memorial Garden

Healer's Refuge

The traveler has almost completed the loop from the front entrance to the rear entrance. Should she choose to traverse the parking lot instead of journeying the entire the length of the Jacob Wheeler Bird Memorial Garden, she will arrive a Healer's Refuge, a small island in the parking lot where she can take a brief rest on a bench before the climbing the existing stairs leading to the spruce walk. She can sit under the shade of a red maple and the beauty of a foster's holly. She will need the rest before climbing the 10-foot heigh stairs. While not a major destination, Healer's refuge offers people the chance to sit down and take a drink and rest after a potentially tiring journey. The added greenery also helps offset the urban heat island effect caused by the abundance of asphalt on the site.

Biodiversity legend

	Scientific Name	Common name	Desired wildlife				
	Acer rubrum	Red maple	wood peckers and song birds	Northern Cardinal	American robin	Pileated woodpecker	Scarlet tanager
	Ilex x attenuata 'fosteriori'	Foster's Holly	song birds	Northern Cardinal	American robin	Eastern blue bird	Tufted titmouse

0' 5' 10' 20'

1"=10'-0"
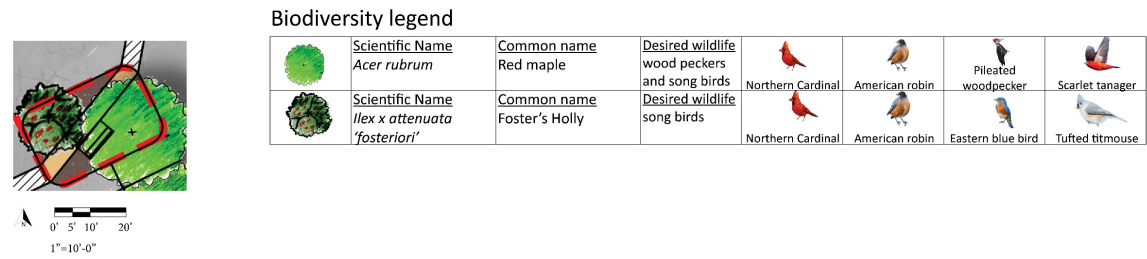
Figure 56: Site plan of Healer's Refuge

Spruce Walk

0' 5' 10' 20'

Healer's Refuge

Jacob Wheeler Bird Memorial Garden

Figure 57: Section Elevation of Spruce Walk, Healer's Refuge, and the Jacob Wheeler Bird Memorial Garden

Spruce Walk

The last proposed destination is spruce walk, named after the existing Norway spruces, seen on the section above.). I increase biodiversity in this area by taking 5 feet from the adjacent drive, reducing it from 20 feet to 15 feet, making it a single lane (It already functions as a one way lane as only one car is allowed to pass at a time. I plant the space with dwarf Burford holly. Clethra, and

Spruce Walk

Sign

Existing tree

Existing Norway Spruce

Deck seating

0' 10' 20' 40'

1"=20'-0"

Eastern dogwood which attract various wildlife. A 5-foot-wide sidewalk parallel to the Norway Spruces takes the traveler to the rear entrance or to the Jacob Wheeler Bird

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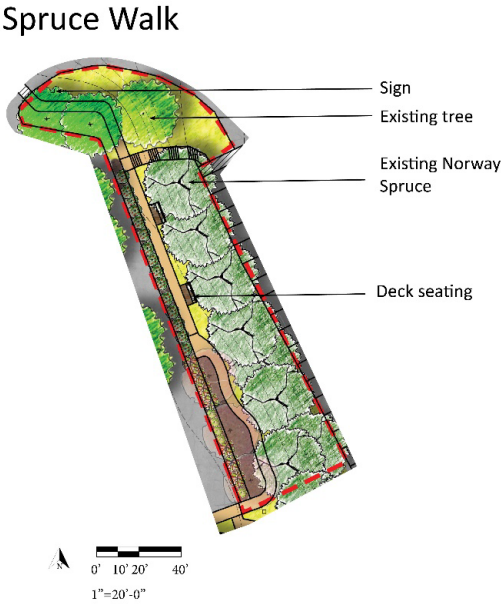
Memorial Garden. Two 10 feet by 5 feet decks are placed along the path to provide seating in the shade. In addition to providing shade, the spruce provide privacy for those sitting on the benches on the deck and for those on the parking lot below. After the moving through the spruce walk, the traveler makes her way to the existing picnic area before arriving at the rear entrance.

Biodiversity legend

	Scientific Name	Common name	Desired wildlife					
	Acer rubrum	Red maple	song birds	American robin	American goldfinch	Northern cardinal	Eastern bluebird	Pileated woodpecker
	Scientific Name Cornus Florida 'Gulf pink'	Common name 'Gulf Pink' Flowering dogwood	Desired wildlife Song birds	Eastern bluebird	Gray catbird	American robin	Scarlet tanager	tufted titmouse
	Scientific Name Ilex Cornuta 'Burfordii nana'	Common name Dwarf Burford holly	Desired wildlife Song birds	Carolina chickadee	American robin	Cedar waxwing	Eastern bluebird	tufted titmouse
	Scientific Name Hydrangea quercifolia	Common name Oakleaf Hydrangea	Desired wildlife Song birds	Pearl crescent	Spicebush swallowtail	Eastern tiger swallowtail	Northern cardinal	Carolina chickadee
	Scientific Name Clethra alnifolia 'Hummingbird'	Common name 'Hummingbird' summersweet	Desired wildlife Butterflies and hummingbirds	Pearl crescent	Spicebush swallowtail	Eastern tiger swallowtail	Great spangled fritillary	Eastern tailed blue

Table 10: Biodiversity legend for spruce walk.

Maintenance

The existing and proposed plant material must be maintained to keep a well kempt appearance. With one exception, all the proposed plants are adapted to the existing conditions of the site. The scarlet bee balm, which is in the Roger Carrol Memorial Garden, cannot be allowed to dry out because it is not drought tolerant. The Clethra alnifolia 'hummingbird' should be watered deeply every two weeks until it is established. The perennials, except for the Pennsylvania sedge, should be cut back to the ground every fall after they are done blooming for the season. Regarding the existing vegetation by the detention pond and Covid Memorial Garden, all invasives (except for the Japanese stilt grass) should be removed. Because of its quantity and prolific self-seeding, it is not feasible to remove all the stilt grass. Existing trees can be pruned at the desired height to let in light and make the forest a less scary place for people.

Chapter 5: Discussion

Biodiversity and well being

My thesis asks how biodiversity and green infrastructure can be utilized to foster general health and wellbeing in the context of a design for Medstar Montgomery Medical center. My secondary question investigates the relationship between the quantity and quality of biodiversity, green infrastructure, and psychological wellbeing in the proposed design. I learned that biodiversity in the form of birds, butterflies, and plants with seasonal color elicit soft fascination and encourages building capacities via exercise as people wander and investigate what they see. Regarding the second question, as long an environment is structured and legible, and visibility is clear, people are comfortable with dense, biodiverse bioretention in green infrastructure. Quality of species, and not quantity of any one species, is most important. People prefer colorful birds and butterflies and the plants in my design attract these valuable creatures. People may experience fascination as they see a cardinal perched atop a service berry. For people who do not enjoy nature, my design provides four places where the plantings should not attract too many stinging visitors. The existing Healing Garden remains as it is and offers a quiet place to rest. Serenity Way contains mostly little blue stem and black-eyed Susans. While they might attract a few bees every now and then, they should not be a problem. Lastly, spruce walk contains mostly evergreens such as dwarf Burford Holly and Norway Spruce. Except for the Clethra and the spring blooms of the holly, nothing attracts stinging insects. The existing picnic area in the back should also provide a welcoming area to sit free from overmuch wildlife as this area contains few flowering plants.

The program

For my design, I created a program in which I proposed to include many kinds of paths and destination features that encourage people to wander and investigate. I proposed to include wayfinding, safe routes, and accessible entrances to the garden spaces. Thirdly, I aspired to provide colorful plantings with seasonal interest that benefits friendly wildlife such as birds and butterflies. In addition, I aimed to filter the view of urban features such as parking lots and cars to make people feel more relaxed. Lastly, I aimed to provide shelter from the sun as well as private and social seating, allowing people to choose their setting.   These destinations ensure that people can have a positive outdoor experience even if they do not have time to travel to the Jacob Wheeler Bird Memorial Garden. I provided many kinds of routes and destinations by creating secondary paths in the Healer's path Healing Garden and making gardens such as the Roger Carrol Memorial Garden and the Healing Garden more accessible. Wayfinding signs ensure people can find their way to the Jacob Wheeler Bird Memorial Garden and creating pedestrian islands in the parking lot makes the journey safer as well as more accessible. The mostly native plantings build up the color in key destinations such as the Healer's Path Healing Garden and the Jacob Wheeler Bird Memorial Garden. The parking islands contain shrub boarders filtering the view of the parking lot and the plantings in the Jacob Wheeler Bird Memorial Garden screen the parking lot as pedestrians embark on the elevated structure. The journey is filled with many seating opportunities. People can choose if they want to sit in the sun or the shade in the Healer's Path Healing Garden. They can either sit alone tucked in a corner or sit with other people if they choose. The addition of Adirondack chairs to the Jacob Wheeler Bird Memorial

Garden provides flexible seating and keeps it away from the shade. The addition of the firepit offers the opportunity for sitting alongside a fire where staff can have cookouts.

Limitations

The major limitations to my thesis were time and the Covid pandemic, which effected the time it took to develop the survey. Due to delays and requests for modifications, creating and making sure the survey was distributed took up most of my efforts during the Fall of 2021. The survey, focus group and GATE questionnaire, reduced the amount of time I could dedicate to site inventory and analysis as well as design. Another factor that limited my design was a constantly shifting goal. Originally, I intended to produce a design for the Covid Memorial Garden and the area with the detention pond. Over the fall, the front entrance was added at the request of my advisor and the whole property became my focus at the order of my committee. Hence, the amount of detail and attention I could give to each of my proposed interventions was limited. Had I chosen a smaller site for my thesis, this problem could have been avoided and a more refined design produced.

Chapter 6: Conclusion

Although my time was limited due to the Covid Pandemic, learned a lot from this endeavor. Initially, I believed people would prefer more biodiversity given the biophilia hypothesis. From the literature review, survey, and focus group, I learned that biodiversity is appreciated up to a certain point. While people love colorful plants, birds, and butterflies, people are not always fond of bees, reptile, and spiders. Dense vegetation is also frightening to some. While it would be ideal to find a diverse native plant pallet that attracted butterflies and birds while excluding bees entirely, this places a significant restriction on the plants that can be used. Welcoming biodiversity into a hospital setting will always be controversial. If it wasn't my thesis question would not be all that interesting and consequently not worth investigating at all. As the world continues to develop, people receive less exposure to the natural world. Since people are often afraid of new experiences, exposure to wildlife may provoke anxiety. As mentioned earlier in the paper, getting outside of our comfort zone, and gaining new experiences is essential to our health and wellbeing. The more we insulate ourselves from nature, the more impoverished our experience of life becomes. By giving people the choice to either sit in a setting filled with bird, butterflies (and bees) or sit in a setting that attracts less of these creatures, people are not forced outside of their comfort zone but have the opportunity to overcome them if they desire.

Appendices

Wildlife Inventory

	Common Name	Scientific Name
Butterflies	Eastern Tiger Swallowtail	*Papilio glaucus*
	Spicebush Swallowtail	*Papilio Troilus*
	Cabbage White	*Pieris rapae*
	Clouded Sulphur	*Colias philodice*
	Eastern Tailed Blue	*Everes comyntas*
	Great Spangled Fritillary	*Speyeria cybele*
	Pearl Cresent	*Phyciodes tharos*
	Mourning Cloak	*Nymphalis antiopa*
	Silver-spotted Skipper	*Epargyreus clarus*

*Table 11 Park wildlife inventory for Rachel Carson Conservation Park (*Montgomery Planning: Master Plans - Olney & Vicinity Environmental Resources Inventory*, n.d.)*

	Common Name	Scientific Name		Common Name	Scientific Name
Birds (*=breeding; **=breeding forest interior spp)	pied-billed grebe	Podilymbus podiceps	**Birds** (*=breeding; **=breeding forest interior spp)	European starling*	Sturnus vulgaris
	hooded merganser	Lophodytes cucullatus		Brown-headed cowbird	Molothrus ater
	mallard*	Anas platyrhynchos		red-winged blackbird*	Agelaius phoeniceus
	American black duck	Anas rubripes		Baltimore oriole*	Icterus galbula
	wood duck*	Aix sponsa		common grackle*	Quiscalus quiscula
	ring-necked duck	Aythya collaris		house finch*	Carpodacus mexicanus
	common goldeneye	Bucephala clangula		American goldfinch*	Carduelis tristis
	ruddy duck	Oxyura jamaicensis		grasshopper sparrow*	Ammodramus savannarum
	Canada goose*	Branta candensis		white-crowned sparrow	Zonotrichia leucophrys
	great blue heron	Ardea herodias		white-throated sparrow	Zonotrichia albicollis
	green heron*	Butorides virescens		chipping sparrow*	Spizella passerina
	American woodcock	Scolopax minor		field sparrow*	Spizella pusilla
	wild turkey	Meleagris gallopavo		dark-eyed junco	Junco hyemalis
	rock dove*	Columba liva		song sparrow*	Melospiza melodia
	mourning dove*	Zenaida macroura		swamp sparrow	Melospiza Georgiana
	turkey vulture	Cathartes aura		eastern towhee*	Pipilo erythrophthalmus
	black vulture*	Coragyps atratus		northern cardinal*	Cardinalis cardinalis
	red-tailed hawk*	Buteo jamaicensis		indigo bunting*	Passerina cyanea
	red-shouldered hawk**	Buteo lineatus		scarlet tanager**	Piranga olivacea
	American kestrel*	Falco sparverius		tree swallow*	Tachycineta bicolor
	barred owl**	Strix varia		cedar waxwing*	Bombycilla cedrorum
	eastern screech-owl*	Otus asio		red-eyed vireo**	Vireo olivaceus
	great horned owl*	Bubo virginianus		yellow-throated vireo**	Vireo flavifrons
	yellow-billed cuckoo*	Coccyzus americanus		blue-headed vireo	Vireo solitarius
	belted kingfisher*	Ceryle alcyon		white-eyed vireo*	Vireo griseus
	hairy woodpecker**	Picoides villosus		worm-eating warbler**	Helmitheros vermivorus
	downy woodpecker*	Picoides pubescens		northern parula*	Parula Americana
	yellow-bellied sapsucker	Sphyrapicus varius		yellow warbler*	Dendroica petechia
	pileated woodpecker**	Dryocopus pileatus		black-throated blue warbler	Dendroica caerulescens
	red-bellied woodpecker*	Melanerpes carolinus		yellow-rumped warbler	Dendroica coronata
	northern flicker*	Colaptes auratus		palm warbler	Dendroica palmarum
	chimney swift	Chaetura pelagica		prairie warbler*	Dendroica discolor
	ruby-throated hummingbird*	Archilochus colubris		ovenbird**	Seiurus aurocapillus
	great crested flycatcher*	Myiarchus crinitus		Louisiana waterthrush**	Seiurus motacilla
	eastern phoebe*	Sayornis phoebe		Kentucky warbler**	Oporornis formosus
	eastern wood-pewee*	Contopus virens		common yellowthroat*	Geothlypis trichas
	Acadian flycatcher**	Empidonax virescens		yellow-breasted chat*	Icteria virens
	willow flycatcher*	Empidonax traillii		house sparrow*	Passer domesticus
	blue jay*	Cyanocitta cristata		northern mockingbird*	Mimus polyglottos
	American crow*	Corvus brachyrhynchos		gray catbird*	Dumetella carolinensis
	fish crow*	Corvus ossifragus		brown thrasher*	Toxostoma rufum

*Table 12: Park wildlife inventory for Rachel Carson Conservation Park (*Montgomery Planning: Master Plans - Olney & Vicinity Environmental Resources Inventory*, n.d.)*

	Common Name	Scientific Name		Common Name	Scientific Name
Birds (*=breeding; **=breeding forest interior spp)	Carolina wren*	*Thryothorus ludovicianus*	**Birds** (*=breeding; **=breeding forest interior spp)	golden-crowned kinglet	*Regulus satrapa*
	house wren*	*Troglodytes aedon*		ruby-crowned kinglet	*Regulus calendula*
	winter wren	*Troglodytes troglodytes*		blue-gray gnatcatcher*	*Polioptela caerulea*
	brown creeper	*Certhia americana*		wood thrush**	*Catharus mustelinus*
	white-breasted nuthatch*	*Sitta carolinensis*		veery*	*Catharus fuscescens*
	tufted titmouse*	*Baeolophus bicolor*		American robin*	*Turdus migratorius*
	Carolina chickadee*	*Poecile carolinensis*		eastern bluebird*	*Sialia sialis*

*Table 13: Park wildlife inventory for Rachel Carson Conservation Park (*Montgomery Planning: Master Plans - Olney & Vicinity Environmental Resources Inventory*, n.d.)*

HEALTHCARE
GARDEN
EVALUATION
TOOLKIT

GARDEN ASSESSMENT TOOL FOR EVALUATORS

INSTRUCTIONS — PLEASE READ BEFORE YOU BEGIN

STEP 1: ESTABLISH CONSENSUS
There should always be at least two evaluators. Evaluators must agree on the 1) Garden boundaries 2) Main doorway 3) Primary pathway.

STEP 2: WALK THROUGH THE GARDEN BEFORE YOU START
Think of the garden from the point of view of a frail patient. Walk through the entire garden, test the furniture, look at the area from different positions — including wheelchair and child height. Ask yourself, "How well does this garden support the needs of patients, visitors, and staff?"

STEP 3: EVALUATE THE GARDEN
For each statement on the next five pages, check the box that best represents your level of agreement. If you are unsure or if the statement is not applicable (N/A), check the last box. Note: It is better to check "Not sure or N/A" than to make a guess! A tape measure will be useful for some of the items.

STEP 4: RETURN THE FORMS
Questions or concerns? Email nsachs@healinglandscapes.org or call (845) 264-2026.

GENERAL QUESTIONS

01	Your name:		
02	Your role/profession (landscape architect, nurse, etc.):		
03	Date:	Time:	AM or PM (circle one)
04	Weather (sunny, cloudy, windy, etc.):	Temp (°F or warm, cool, etc.):	
05	Name of facility and location (city, state):		
06	Name of garden (if it is named):		
07	Type of facility or patients served:		
08	Location and type of garden (e.g., front entry, central coutyard, rooftop, etc.):		
09	Are there other gardens and/or outdoor sitting areas at the facility?	YES	NO
	If YES, please list:		

OVERALL RATING

NOT RESTORATIVE AT ALL ⟶ COMPLETELY RESTORATIVE

✳ On a scale of 1-10, how would you rate the **overall restorativeness** of this garden? *"Restorative"= Able to restore a person's strength, health, or well-being.*	1	2	3	4	5	6	7	8	9	10

Table 14: Page 1 of the Garden Assessment Tool for Evaluators (Sachs, 2017)

For each item, **check the box that best represents your level of agreement.** If you are unsure or if the statement is not applicable (N/A), check the last box.

ACCESS & VISIBILITY 1

VISUAL ACCESS TO THE GARDEN	STRONGLY AGREE	SOMEWHAT AGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
01 Garden is **visible from main public indoor areas** (entry lobby, major hallway, etc.).					
02 Garden is **visible from indoor areas that involve waiting** (waiting rooms, labs, pharmacy, etc.).					
03 Garden is **visible from floors above** (from offices, patient rooms, etc. on upper floors).					
04 **Entrance to the garden is easy to find.**					
05 **Doors to the garden are glass or have a window in or next to them.**					
06 **Garden looks appealing/inviting from indoors.**					
07 There is **signage TO the garden from indoors** (in lobby, waiting areas, elevator, etc.).					
08 There is **signage for the garden ON OR NEXT TO garden doors.**					
09 **Information about the garden** is available (through pamphlets, signage, website, etc.).					

PHYSICAL ACCESS TO THE GARDEN	STRONGLY AGREE	SOMEWHAT AGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
10A Garden is **open 24 hours** a day, 7 days a week.	YES			NO	
10B If garden is NOT open 24/7, what hours and days is it open?					
11 Doors to the garden from at least one entry are **automatic and easy to use.**					
12 Any **non-automatic doors are easy to operate** (are not too heavy, don't close too quickly).					
13 Doorway **thresholds are flat and smooth** (for a wheelchair or an IV pole to cross easily).					
14 The **space just outside the main doorway* is covered/roofed** (providing protection from rain, sun, etc.).					
15 The space just outside the main doorway has **seating for at least two people and space for at least one wheelchair.**					
16 A "destination" feature draws people into the garden (seating area, water feature, special tree or plantings, etc.).					
17 A **restroom in the facility is near a garden entry** (about 50 feet).					
18 Garden has an **emergency phone** that connects with the hospital front desk or security.					

* Remember to make sure all evaluators agree on what is the "main doorway."

Table 15: Page two of the Garden Assessment Tool for Evaluators (Sachs, 2017)

SENSE OF "BEING AWAY"	STRONGLY AGREE	SOMEWHAT AGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
01 People can find a **desirable sense of enclosure** in the garden.					
02 People can find **privacy in at least one part** of the garden.					
03 People in the garden **cannot look into adjacent private indoor areas** (patient rooms, treatment/consultation rooms).					
04 Garden has at least one **fully covered (roofed) area** (porch, gazebo, etc.).					
05 At least one **seating area is protected from climatic/weather extremes** (with wind shields, patio heaters, overhead fans, etc.).					
AESTHETICS & MAINTENANCE	STRONGLY AGREE	SOMEWHAT AGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
06 Garden has some features that provide a **rich, multi-sensory experience** (things to do, look at, touch, smell, hear, etc.).					
07 Garden is **free from unpleasant sounds** (air conditioners, traffic, loading docks).					
08 Garden is **free from bad odors** (trash, vehicle exhaust, cooking smells).					
09 Plants **hide or soften unsightly views** (of fences, walls, equipment, etc.).					
10 Garden is **free from trash** (paper, cigarette butts, cans, etc.).					
11 Garden has at least one **trash can.**					
12 There is a **shed or other place to store tools** in the garden.					

Table 16: Page three of the Garden Assessment Tool for Evaluators (Sachs 2017)

PLANTINGS		STRONGLY AGREE	SOMEWHAT AGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
01	**More than half of the garden surface areas are planted** (not paved).					
02	Garden has a **rich variety of plants** (combination of trees, shrubs, perennials; variety of species; etc.).					
03	Garden has **plants at multiple heights** (on the ground, raised beds, hedges, vines, trees, etc.).					
04	Garden has **plants that stimulate the senses** (sight, smell, touch, sound, taste).					
05	Some plants are **intriguing, provide "fascination"** (intricate flowers, unusual growth pattern, movement, etc.).					
06	Planting provides **year-round interest** (always something to see, such as flowers, leaves, berries, bark, evergreens, etc.).					
07	Some plants provide **bright colors** in at least one time/season of the year (with flowers, leaves, berries, bark, etc.).					
08	**Planting BEDS look well-maintained** (well-weeded, no large "bare spots," etc.).					
09	**PLANTS look well-maintained and healthy** (vibrant, well-pruned, etc.).					
10	**Plants are sturdy** enough to tolerate extreme weather, people picking flowers and leaves, etc.					
OTHER NATURAL FEATURES		STRONGLY AGREE	SOMEWHAT AGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
11	**Plants provide food and/or habitat** for birds, butterflies and other desirable wildlife.					
12A	Garden has at least one **water feature**. If NO, skip the next five questions.	YES			NO	
12B	If YES, describe water feature briefly:					
13	Water feature looks **clean and well-maintained.**					
14	Water feature design and location **minimizes slipping hazards.**					
15	Water feature has **minimal splash** (spray from splashing can carry harmful bacteria).					
16	**Sound** from water feature is **pleasant and soothing.**					
17	Some **seating is available near** the water feature (within 15 feet).					

Table 16: Page four of the Garden Assessment Tool for Evaluators (Sachs, 2017)

PRIMARY WALKWAY (PATH OR PAVED THOROUGHFARE)	STRONGLY AGREE	SOMEWHAT AGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
01 Primary walkway is **relatively flat** (not too steep).					
02 Primary walkway **does not have steps or steep ramps.**					
03 Primary walkway is **smooth but non-skid, even when wet.**					
04 Primary walkway is **at least six feet wide** or, if narrower, has frequent passing areas.					
05 Primary walkway has a **curb or raised edges** (to keep wheelchairs, strollers, walkers, canes, etc. on walkway).					
06 Primary walkway has **seating approximately every 30 feet.**					

ALL PAVED AREAS (WALKWAYS AND PATIOS)	STRONGLY AGREE	SOMEWHAT AGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
07 **Gaps or cracks in paving** (walkways and patios) **are narrow** enough for a wheelchair, stroller, or IV pole to cross smoothly.					
08 Paving **does not create glare** (is tinted concrete, colored stone, brick, etc.).					
09 Paved areas are **clear of debris and other obstacles** (twigs, leaves, hoses, etc.).					
10 **Trees/plants along walkways** and other paved areas **do not drop** a lot of leaves, twigs, seeds or fruits.					

LIGHTING, WAYFINDING, & AMENITIES	STRONGLY AGREE	SOMEWHAT AGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
11 There are **landmarks and/or signage in the garden to help people navigate their way through** (and back to the entrance).					
12 **A drinking fountain** is in or near the garden.					
13 Garden has **lighting for night usage.** If NO, skip the next two questions.	YES			NO	
14 If garden has lighting: **Walkways are evenly lit.**					
15 If garden has lighting: **Lighting does not shine into patient rooms.**					

VARIETY & ACTIVITIES	STRONGLY AGREE	SOMEWHAT AGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
16 Garden has **more than one walkway,** with a variety of routes, lengths, and destinations.					
17 At least one **secondary walkway offers increasing levels of difficulty** (with paving material, steepness, steps, etc.).					
18 Garden has **spaces/features for therapists (PT, OT, HT) to work with patients** (handrails, variety of walking surfaces, steps, etc.).					
19 Garden is **safe for children** (e.g., physically enclosed; easily viewed from nearby seating areas; plantings and other features are not harmful).					

Table 17: Page 5 of the Garden Assessment Tool for Evaluators (Sachs, 2017)

SEATING AVAILABILITY & TYPE	STRONGLY AGREE	SOMEWHAT AGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	NOT SURE OR N/A
01 The garden offers **many places to sit.**					
02 People can choose a **variety of types** of seating (benches, chairs, etc.).					
03 **Movable seating** is available (light enough to move but sturdy enough to prevent tipping).					
04 At least **50% of the seating in the garden has backs and arms** (so that people can easily get up and down).					
05 There is a **place where someone could lie down** for a rest (chaise longue, bench, lawn).					
PRIVATE OR SOCIAL					
06 Garden has **separate areas for activities and socializing,** compared with **contemplation/quiet conversation.**					
07 Garden provides a place where **3 or more people can sit together.**					
08 Some seating areas **allow people to interact with passers-by.**					
09 Garden provides **semi-private seating for one or two people.**					
10 Some seating makes it **possible to watch others from a distance.**					
AESTHETICS & SUN					
11 There is a **choice of seating in sun or shade** throughout most of the day.					
12 Seating **does not produce glare** (is not metal, white, etc.).					
13 Seating material **does not get too hot or too cold.**					
14 Seating, tables, and other furniture look **well-maintained.**					
15 Some seating has **attractive or interesting views.**					
TABLES					
16 **Garden has at least one table.** If NO, skip the next four questions.	YES	/////	/////	NO	
17 Some **seats have tables next to them.**					
18 There is at least one table **large enough for four or more people.**					
19 There is at least one **table that can accommodate people in wheelchairs or scooters.**					
20 **Tables do not tip** (for example, when people use as leverage to sit down and get up).					

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Table 12: Page 6 of the Garden Evaluation Tool for Evaluators (Sachs, 2017)

Survey

Medstar Montgomery Medical Center Healing Garden Survey

Thank you for participating in this survey! It should only take 5-10 minutes to complete!

My name is Jonathan Mallory, and I'm a Master of Landscape Architecture Student at the University of Maryland. For my thesis project, I intend to use principles of evidence-based design, landscape aesthetics, site analysis, and restorative environments to produce a design for a possible healing garden at MedStar Montgomery Medical Center (MMMC). I intend to utilize "green infrastructure" (rain gardens, forests, and other environmentally friendly natural areas) and biodiversity (different kinds of plants and animals) in an aesthetically pleasing fashion that augments the restorative quality of the area I want to be a possible healing garden.

Currently, the area I will be designing consists of a gazebo and a few picnic tables (see the picture on the bottom left). In this survey, the area will be called "The Site."

This survey is anonymous. If you have any questions or concerns, please contact me at jmallory@umd.edu or Nathan.Barbo@medstar.net

The site
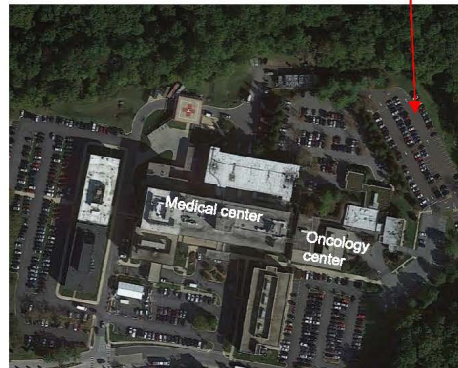
Please continue to the next page for the survey

Figure 73: Page 1 of the Survey

1. What is your role or Department at MMMC?

☐Registered Nurse (RN)   ☐Physician Assistant (PA)   ☐Licensed Nurse Practitioner

☐Nurse Practitioner   ☐Security Personnel   ☐Registration Personnel

☐Certified Nursing Assistant (CNA)   ☐Supply Chain   ☐Medical Assistant (MA)

☐Pharmacy   ☐Social Work/Case Management   ☐Housekeeping

☐Rehab   ☐Administration   ☐Food Services

☐Psychiatry   ☐Technician   ☐Facility Maintenance Personnel

☐Physician (MD)   ☐Volunteer

☐Other (please specify): _____

☐Therapist (Physical, Occupational, Speech, Horticultural, etc.). Please specify _____

☐I prefer not to answer

2. How long have you worked (or volunteered) at MMMC?

☐Less than one year   ☐One year or more (please fill in number here[____])   ☐I prefer not to answer

3. About how many hours per week do you work at MMMC?

☐Less than 20 hours   ☐Approximately 20 hours

☐Approximately 40 hours   ☐Approximately 60 hours or more

☐I prefer not to answer

4. What time do you work at MMMC?

☐Day   ☐Night   ☐Both   ☐I prefer not to answer

5. In good weather, during your breaks at MMMC, do you prefer to be outdoors or indoors?

☐Outdoors   ☐Indoors   ☐I prefer not to answer

6. How often do you visit The Site? (See top of survey for photos and description of "The Site")

☐Often (2 times a week or more)   ☐Sometimes (about once a week)   ☐Occasionally (about once a month)

☐Rarely (a few times a year)   ☐Never   ☐I prefer not to answer

Please continue to the next page for the survey

Figure 74: Page 2 of the Survey

7. In good weather, how likely are you to visit The Site? (Please select one)

☐Very likely   ☐Somewhat likely   ☐ Somewhat unlikely   ☐Very unlikely   ☐I prefer not to answer

8. What attracts you to The Site? (Select as many as apply)

☐Natural beauty

☐Peace and quiet

☐Away from my desk/workspace/department

☐I prefer not to answer

☐Exercise

☐Privacy

☐Interesting Wildlife (birds, squirrels, etc.)

☐Other (please describe):

9. How much time do you typically have to go outside? (Please select one)

☐10 minutes   ☐20 minutes   ☐30 minutes or more   ☐I prefer not to answer

10. What are the biggest barriers to you using The Site? (Select as many as apply)

☐Takes too long to get to

☐Too difficult to get to (too steep, I use a wheelchair or other assisted mobility device, etc.)

☐I don't have time

☐Other (Please describe here): _____

☐I prefer not to answer

☐Too many bugs

☐I don't feel safe

☐Poor cellphone or WiFi reception

☐Nothing to do there

☐Bad weather (too hot, too cold, etc.)

☐Not enough seating

☐Not enough shade

11. Please select your level of agreement with this statement: "The hospital's outdoor environment has a wide number of species of plants and animals (species richness)"?

☐Strongly agree

☐Neither agree nor disagree/unsure

☐Strongly disagree

☐Somewhat agree

☐Somewhat disagree

☐I prefer not to answer

Please continue to the next page in this survey

Figure 75: Page 3 of the Survey

12. Are there other outdoor spaces at MMMC that you visit? If yes, what are they and why do you visit?

☐No

☐Yes (please say what these spaces are and why you visit): _____

_____

☐I prefer not to answer

13. Are there certain types of wildlife (plants and/or animals) on the hospital grounds that you enjoy? Please list.

☐Please list your preferred wildlife: _____

☐I prefer not to answer

14. Are there certain types of wildlife (plants and/or animals) on the hospital grounds that consider a nuisance or threat? Please list

☐Please list undesirable wildlife: _____

☐I prefer not to answer

15. What kind of outdoor services or activities would be helpful to MMMC staff, visitors, and patients?

☐Eating lunch   ☐Meetings or therapy with patients

☐Walking and exercising   ☐Staff meetings

☐Memorial services   ☐Other (please describe): _____

☐I prefer not to answer   _____

_____

16. Is there anything else you would like to share? Please comment below

┌──┐
│   │
│   │
│   │
│   │
│   │
│   │
│   │
└──┘

☐I prefer not to answer

Thank you for participating in this Survey

Figure 76: Page 4 of the Survey

Focus Group Protocol

I. Welcome/Focus group protocol: (3 minutes)

Welcome. Thank you for taking the time out of your busy schedules to be here. My name is Jonathan Mallory and I'm a Masters of Landscape Architecture Candidate at the university of Maryland. I am studying how wildlife and other natural elements improve psychological wellbeing in the context of a healing garden. My purpose here today is to inquire how existing outdoor spaces are used at Medstar Montgomery Medical Center and how to best make use of those spaces for the needs of patients, staff and visitors while incorporating desirable natural elements. I'll be moderating our discussion today.

Before we start, I would like to mention some important facts about our discussion

1. First, our discussion will last approximately 30 minutes to an hour.

2. I also ask that all phones be turned off or put on silent.

3. My purpose is to gather ideas and feedback. There are no right or wrong answers.

4. During the meeting, I would like to hear feedback from everyone. Some of you may prefer to listen while others play a more active role in asking questions. To hear from everyone, I may call on people and ask more energetic responders to keep their feedback within proper time constraints.

5. For the sake of giving you my full attention and for time, this meeting will be recorded with your permission. The information in the recording will be aggregated and analyzed for the purpose of creating design guidelines for a potential healing garden at Medstar Montgomery Medical Center.

6. This focus group is anonymous. Names and other personal information will not be shared outside the discussion other than with me and my academic advisor. Any personal information shared today will be confidential and I ask that what is discussed today not be shared with anyone outside this room.

7. Because this meeting is being recorded, I ask that everyone speak clearly and audibly. I also ask that each of you speak one at a time.

8. If you have any follow up questions after the meeting, please reach out to me

II. Introduction (5 minutes):

Before we begin, I would like to know more about your background and what you do. Please tell me:

1. Your name.

2. The wellness team (what is it and what is its purpose?)

2. What you do for the wellness team.

Figure 77: Page 1 of the Focus Group Protocol

3. Your favorite movie/show.

III. Warm up (10 minutes):

To get us started, I want to hear how you would describe Medstar Montgomery Medical Center. I'll write on the white board, and you can call out words or phrases that come to mind when I say healing garden?

IV. Questions (25 minutes).

1. Do you visit any of the outdoor spaces on the hospital campus?
   a. If yes, ask which ones?
   b. What draws you to the space?
   c. How often?
   d. How much time do you have to stay and how long do you stay?
   e. What do you do there?
   f. If not, what circumstances do you think prevent this?

2. Do you see staff, patients and their families using outdoor spaces?
   a. If yes to either ask which ones?
   b. What do you think draws them to the space?
   c. How often?
   d. How long do they stay?
   e. What do they do there?
   f. If no, what do you think is preventing this?

3. Are there certain settings/gardens that seem to draw people to them? Do you have a favorite garden?
   a. If yes, why do you think so?

4. Are there certain types of plants or animals (flora and fauna) on the hospital campus that you enjoy?
   a. What do you see when you walk outside at MMMC?
   b. What makes these plants and animals attractive?

5. Are there certain types of plant or animals (flora and fauna) on the hospital campus that you consider a nuisance or threat?
   a. Why?.

6. What kind of outdoor services/activities would be helpful to Montgomery General Hospital visitors and patients (e.g., relaxation, meditation, gardening, exercise)?

8. Show everyone a picture of the Covid Memorial Garden and describe where it is on the grounds)

   • What are some positive aspects about the Site?
   • What are the negative

Figure 78: Page 2 of the Focus Group Protocol

9. (Show a picture of the Front entrance garden)

- What are the positive aspects of the site?
- What are the negative aspects of the site?

V. Conclusion (5 minutes)

1. What is one important thing that makes an outdoor space special?

2. Is there anything else I should know?

Thank you all so much for your time.

Figure 79: Page 3 of the Focus Group Protocol

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