ABSTRACT

Title of Document: CHANGING COURSE: REPURPOSING GOLF LANDSCAPES FOR WILDLIFE HABITAT AND RECREATION

Nicholas William Yoder,
Masters of Landscape Architecture, 2015

Directed By: Associate Professor, Mr. Jack Sullivan
Plant Science Landscape Architecture

More than 1,400 golf facilities in the United States have closed permanently since 2001, part of a natural supply correction, as well as a reflection of the fluctuating interest in the game. Through their design, golf courses inherently preserve a singular form of open, green space. In their most dynamic form, they are culturally integral landscapes with vibrant ecosystems that provide wildlife habitat. They represent some of the largest 'undeveloped' spaces in United States' cities. Each golf course closing represents a single patch of many that, with sound design, could be woven together through a common purpose, like a landscape quilt. Through a site-specific analysis, the resulting design proposal for Wakefield Wildlife Reservation is a new type of landscape for the city of Westminster, MD, serving as an example for future projects. It will provide valuable habitat and dynamic recreational space, while expressing site and regional history.

CHANGING COURSE: REPURPOSING GOLF LANDSCAPES FOR WILDLIFE HABITAT AND RECREATION

by

Nicholas W. Yoder

Thesis submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Masters of Landscape Architecture
2015

Advisory Committee:

Professor Jack Sullivan, Chair
Dr. Mark Carroll
Dr. Kelly Cook

Table of Contents

Table of Contents……ii

List of Tables……..iii

List of Figures…….iv

Chapter 1: Introduction……1

Chapter 2: Literature Review……...8

Origin and History of the Game……..8

Nationwide Inventory and Trends……...…13

Cultural and Ecological Value of the Golf Courses……..…15

Nature and Culture……..…19

Wildlife Habitat and Recreation……..…20

Chapter 3: Case Studies……..26

Acacia Reservation……..…….26

Orchard Hills Park……..……..31

Chapter 4: Site Selection……..34

Chapter 5: Site Inventory and Analysis……..39

Chapter 6: Design Framework and Design Development…..…….58

Design Framework……..…58

Design Development……..…59

Chapter 7: Design Solution, *Wakefield Wildlife Reservation*……..63

Design Details……..……..66

Chapter 8: Conclusions…..……...80

Bibliography……..……..……..83

List of Tables

Table 4.1: Site Selection Matrix…….……36

Table 7.1: Plant List for Grasslands, Meadows, Barrens……...70

List of Figures

Figure 1.1: Golf Course Research Topics……1

Figure 1.2: Basic Components of Golf……2

Figure 1.3: Vegetation Gradient, Typical Golf Hole……...5

Figure 2.1: View of St Andrews from the Old Course, c.1740……11

Figure 2.2: “The Golfers” by Charles Lee……11

Figure 2.3: Golf Courses in the Middle of Ecological Resources and Development……15

Figure 3.1: Acacia Meadow Ecosystem……..…27

Figure 3.2: Common Hydrologic Opportunities……29

Figure 3.3: Cart paths repurposed as trail systems……32

Figure 3.4: Secondary Trails and Strategic Viewing Areas……...32

Figure 3.5: Layered Herbaceous Understory……33

Figure 3.6: Reforestation and Native Meadow Establishment……...33

Figure 4.1: Edge Studies……35

Figure 4.2: Radius Diagrams……36

Figure 4.3: Wakefield Valley Golf Course……38

Figure 4.4: Views of Wakefield Valley after Closure……...38

Figure 5.1: Wakefield Valley Regional Context……39

Figure 5.2: Westminster, MD Zoning Map……...……40

Figure 5.3: Housing Typology around Wakefield Valley…….……41

Figure 5.4: Relevant Context…….……42

Figure 5.5: Carroll Country Barn Quilt Trail Information…….……44

Figure 5.6: Wakefield Valley Geologic Map…….……45

Figure 5.7: Images of Agricultural Legacy……46

Figure 5.8: Historic Elements around Wakefield Valley…….…..……46

Figure 5.9: Wakefield Valley Soil Survey…….……47

Figure 5.10: Diagram of Three Ecosystem Zones……..……..……..…48

Figure 5.11: Wakefield Valley Base Map…….……..……48

Figure 5.12: Existing Forest Cover…….…..……..…50

Figure 5.13: Stream Underpass, Wildlife Movement……..……..……51

Figure 5.14: Existing Stream Conditions…….……...……52

Figure 5.15: Existing Pond and Wetland Conditions…….…...……53

Figure 5.16: Existing Herbaceous Vegetation……...……54

Figure 5.17: Images of Wakefield Valley Wildlife……...…55

Figure 5.18: Existing Microclimates……..……...…56

Figure 5.19: Vantage Points for Good Views……57

Figure 5.20: Vehicular Circulation Diagram, Images……57

Figure 6.1: Preliminary Design……..……61

Figure 6.2: Second Preliminary Design Iteration……..……61

Figure 6.3: Labeled Preliminary Design……62

Figure 6.4: Fairway to Early Successional Meadow Image……..62

Figure 7.1: Target Habitat Zones……...……63

Figure 7.2: Ecological Restoration Strategies……..……..…64

Figure 7.3: Intensity of Use Diagram……65

Figure 7.4: Functional Diagram…….……66

Figure 7.5: Wakefield Wildlife Reservation Master Plan……..……66

Figure 7.6: Overarching Habitat Zones……..……68

Figure 7.7: Perspective of Great meadow and Promontory Look-out Tower…….……...……69

Figure 7.8: Section of Sequenced Reforestation…….……...……70

Figure 7.9: Perspective of Sequenced Succession, Habitat Gardens…….……71

Figure 7.10: Perspective of Large Pollinator Habitat, Butterfly House, Sculpture……72

Figure 7.11: Section of Connection to Carroll Lutheran Village, Therapeutic Garden…….……73

Figure 7.12: View of Therapeutic Garden Area, Ponds, Land-bridge…….…..……74

Figure 7.13: View of Habitat Garden, Roosts, Vertical Flush Buffer……...……74

Figure 7.14: Adventure Trail Section; Habitat Zones Relationships, Anticipated Wildlife….....75

Figure 7.15: Daylight Stream, Riparian Vegetation Succession……76

Figure 7.16: Bat-house Habitat Garden…….……77

Figure 7.17: Section by Pedestrian Entrance, Buffer Establishment, Viewing Platform……..…77

Figure 7.18: White Pine Meadow Trail, Spatial Transformations…….……78

Figure 7.19: Example of Sequenced Succession……...……79

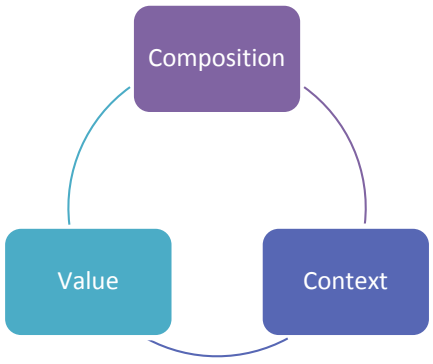
Chapter 1: Introduction

Golf courses emerged in the United States in the early 20th century. Since then, the industry has gone through several stylistic design eras and periods of great proliferation dependent on the popularity of the game. As a whole, the number of golf courses in the United States continued to rise through the 1990's and totaled around 16,000 at the turn of the 21st century.

Over the last decade and a half, for a variety of reasons ranging from decreased interest, changing attitudes or expectations, economic shifts, or a saturated market, the number of golf courses in the United States has consistently decreased. Since 2008, 100-200 golf courses have closed each year (National Golf Foundation, 2014). This makes the consideration of what to do with golf course landscapes a relevant endeavor for planners and landscape architects. As such, a thorough understanding of golf courses is necessary to move forward with success.

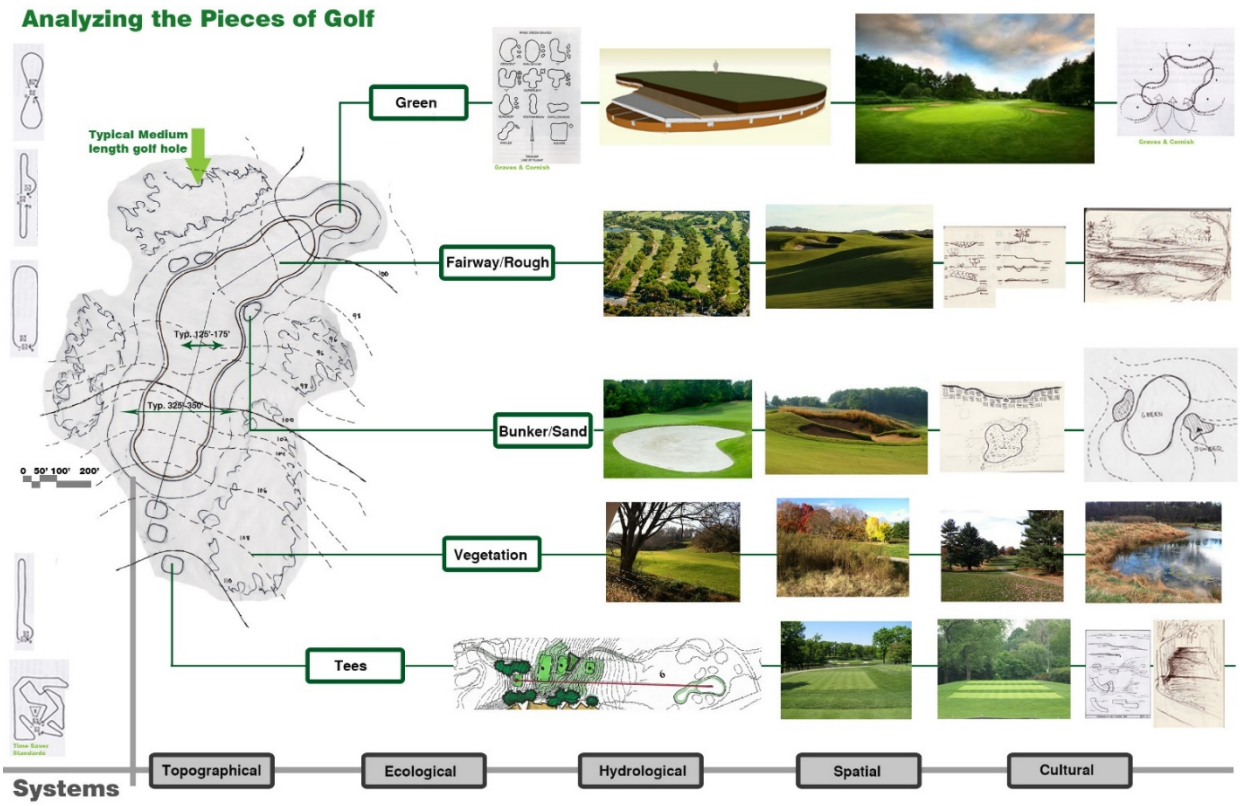
Understanding the existing conditions of golf courses is a key to determining what we should do with them next. Accordingly, three fundamental aspects of golf courses were targeted early in this research; 1) Composition, 2) Context, and 3) Value (fig. 1.1). Focusing research in these three basic areas helped to determine commonalities and differences, and what golf courses mean to the ecosystems and communities they serve. This information was augmented through site visits, edge analysis, component analysis, literature reviews and case studies of formerly repurposed golf courses, parks, and wildlife preserves. Considerations of how golf courses contribute to the larger ecosystem, the modular possibilities of adaptive reuse, and the relationship of the landscapes to the built environment were all part of the research process. The answers to these questions ultimately helped craft the framework developed in this project and informed the design solution.

Figure 1.1: Golf Course Research Topics



The formation of the components of a golf course is a story of recreation shaping the landscape over time. The basic components that make up golf courses are greens, fairways, rough, vegetation, tees, and bunkers (fig. 1.2). Other elements common to golf courses are clubhouses (of widely varying size), streams and ponds, maintenance buildings, irrigation systems, cart paths, roads, and integrated or bordering housing developments. It is important to note that the form, character, and material used on golf courses vary with physiographic region in order to remain somewhat sustainable landscapes. But regardless of these physiographic differences, it is clear that golf courses share many commonalities of which need to be understood to discover their value to a repurposing project. These elements are outlined in this section in regards to their basic composition as well as some historical notes about how they formed, or evolved.

Figure 1.2: Basic Components of Golf



The landscape components of the typical golf course are outlined above. Tees are relatively level turfgrass areas that function as the space where the golfer begins each

hole. They generally range around 1,000- 2,000 square feet, but can be much smaller or larger depending on the course's design. Often, there are two or three teeing areas on each hole to accommodate players of varying skill levels, i.e. people who hit the ball shorter distances generally start play of each hole closer to the target green. Since the green is the ultimate end of each hole, tees reside at the opposite end of the fairway than the green of the same hole. As shown in the diagram, the tee for each subsequent hole is usually close to the previous green to allow for efficiency of play. Originally teeing areas were in the same space used for the putting green, the procedure was to place the ball as nearest as possible to the previous hole to hit the first shot for the next hole (Browning, 21). Gradually players realized the value of separating these two functions on the golf course because a smooth putting surface was preferred and tee shots can make divots in the ground that disrupt the roll of a putt. As further safety and maintenance considerations came to the forefront, the two areas were made into separate spaces on the vast majority of courses.

A putting green is a relatively flat area, often with subtle contours of one or two feet, where the flagstick and hole reside; the ultimate target for the golfer's ball. The typical green is 5,000-8,000 sq. ft. However, like teeing areas, they come in a wide variety of shapes and sizes based on the existing landscape and the intended course design. The preferred turfgrass for greens in this region is bentgrass. Greens are often visual focal points; prominent termination points at the end of hundreds of yards of long, thin, open space called fairways. This is a fundamental component of golf course design that creates a unique landscape aesthetic. The dense turfgrass on the greens is mown short to produce a smooth, vegetative carpet conducive for a true roll of the golf ball which facilitates fair competition, established on top of a highly modified soil profile to promote proper drainage and mitigate compaction.

Greens were not always the lush, rolled, constructed turf plateaus of today. They are byproducts of a target being placed in the ground to aim at. The result was that the area around the target was gradually worn down through wear and compaction, which promoted a more consistent roll of the golf ball. Soon players began to augment that landscape characteristic for its positive impact on the quality of the game. They even used rabbit and sheep to help keep the turf short. In fact, some courses relied exclusively on rabbits to keep the grass cut all the way up through the mid-20th century (Campbell, 9). However, in order to maintain the greens to the desired quality in contemporary design and installation there is a precise subsoil and sub-drainage system usually installed for the upper 12-18' of profile underneath the green area. The well-drained soil profile and prominent focal quality of greens that developed over centuries remains a unique feature of golf courses that makes an interesting consideration for a retrofitting project.

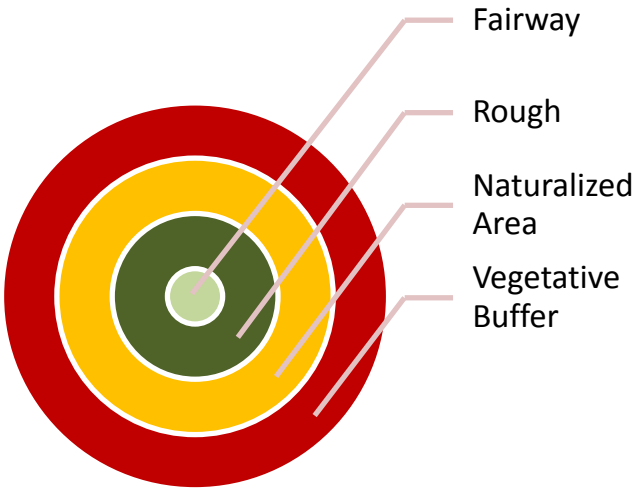
The fairway is the main avenue of play from tee to green. Typically the fairway is a 125'-150' wide strip of quarter to half-inch-long turfgrass running down the center of a

larger concentric gradient of vegetation which progresses outwardly from fairway, to rough, to naturalized area, to vegetative buffer (fig. 1.3). Fairway length can range from 80-600 yards, and greatly determines the 'par' value for a hole, usually being either a par 3, 4, or 5. The topography of the fairway is generally flat or canted to one side, but often includes rolling undulations and landing plateaus to provide for more interesting roll and bounce of the ball, and more challenging stances and shots. Common turfgrasses used in this region for fairways are bentgrass and bermudgrass.

Spatially, having several holes subsequent and adjacent to each other creates a familiar landscape pattern unique to golf courses. Walking along the intended line of play there is an obvious sequence to the space. If you walk perpendicular to the way the holes are laid out, there is often an alternating pattern of open space, tree buffer, open space, tree buffer, and so on. These 'green hallways' that make up a typical golf hole can be 130-160 yards wide or more, from buffer to buffer. Even holes that lack vegetative buffer on one or both sides require some amount of space between holes for safety and liability purposes. Though fairway turf is not kept as intensively as the greens, it is still mown relatively short and receives maintenance several times a week, if not daily. Having a narrow fairway typically makes a golf-hole play more difficult, and can accentuate the spatial quality of enclosure, especially if the tree buffers are narrow.

Fairways developed organically over decades of play through wear and compaction. It didn't take long to realize that loosing ones golf ball was frustrating, so it was beneficial to keep the ball in areas of shorter vegetation. Once players realized the ball rolled better, went further, and it was easier to hit the ball off of shorter turf, patches of short grass or sand were chosen more often as landing points. An interesting part of the reason these patches of grass existed at the time was because of the grazing and hunting of rabbit and fox that helped create flat clear expanses in the links land (Campbell, 14-16). This historical relationship between hunting wildlife and the formation of golf courses is an interesting parallel to a repurposing project that deals with habitat creation on golf courses. But regardless, the fairway maintains large patches of open space in the landscape, similar in form to meadows or grasslands, which have dynamic ecosystem potential.

Figure 1.3: Vegetation Gradient, Typical Golf Hole



Rough is made up of wide strips of longer grass surrounding the fairway on both sides to serve as a penalty and to slow errant shots. These areas generally demand less maintenance than the greens and fairways. In this region, tall fescue is the grass of choice in most cases, and fine fescue is increasingly being used in low-mow or no-mow areas. It is common to find on many public courses that the further away you get from the fairway edge, the more bare-spots, crab-grass, or rocky areas you encounter as you get closer to the forest edge or vegetative buffer. This is simply due to maintenance efforts and turfgrass establishment being concentrated toward the areas that receive more use.

There is often another tier of grasslands interwoven within and around many courses which are referred to as naturalized areas. Usually they are established in parts of the courses considered out-of-play, and are becoming more and more common because they require much less maintenance than the other components of the golf course. They are most common in wet areas and in areas between the rough and the vegetative buffers. The variety of grass covering these areas depends on the region, the design intent, and the desired maintenance input. Regionally some common native grasses in these areas are big bluestem, little bluestem, indiangrass, and switchgrass. Naturalized areas can also serve as another strategic element infused into the course.

In addition to the various types of grasses, golf courses have many other vegetative components that function as buffers between holes. These elements vary with physiographic region and hardiness zone, but their functions are similar. Some courses have no trees at all. But most often in the United States evergreen trees are used as buffers between parallel fairways, acting as vertical hazards around the fairways and green-necks, effectively ‘pinching’ the aerial access to the target. Evergreens are more commonly used than deciduous trees because they provide a year-long buffer to block

errant shots, help with visual separation of the fairways for better sense of solitude, and don't drop leaves which can make it difficult to find golf balls.

In addition to vegetation, water resources in the form of streams, ponds, and wetlands can be found on nearly every golf course. Irrigation demands for turfgrass and drainage patterns designed to move water away from fairways, greens, and tees, are some of the reasons that new water bodies are created during golf course design and construction. While disrupting the natural hydrology, this element does help to provide more landscape diversity, strategic variation, and create wildlife habitat for waterfowl, fish, and amphibians. The earth-moving required to build fairways and greens in some situations also requires stormwater compensations that demand new ponds or wetlands to be installed. Additionally, many golf courses are built in floodplain valleys. This land is not ideal for other types of development and often functions to help protect water quality if effectively designed and managed.

Bunkers or sands traps are relatively shallow (0-6 ft.) sandy pits placed in strategic locations to affect the aim, roll, and bounce of the golf ball. They are most often placed around greens and fairway edges, and can have an impact on the way a golf visualizes and therefore executes a golf shot. The sandier the natural soil profile, typically the more bunkers a golf course has, as they are easier to maintain because of their organic composition and natural drainage.

There are several theories on how bunkers became part of the golf course. Some are said to have developed through decades of wear; dug from repeated swings of the club into the sandy earth. Deep gashes formed in the soil that could not heal owing to the inherent tendency of the golf ball to settle there in the low area. In this way, by forming in the very places the ball was most likely to roll, they became the ultimate hazard and strategic influence. Others believe bunkers were made by rabbit scratches or that they represent an abstraction of what used to be herds of sheep against which rolling balls often came to rest. Regardless of how they formed, the low-lying quality of many bunkers causes them to collect water if not properly and consistently maintained.

From the initial research it is clear that the typical golf course is constructed within an ordered set of design principles, like most competitive sporting landscapes. Certainly football fields and golf courses are on opposite sides of the spectrum in regard to the regularity of their makeup and dimensions. Nonetheless, there is an order to golfs fairways, greens, tees, and buffers, within an established framework that creates the potential to use transferrable design practices when repurposing golf courses. Exploring these elements helps establish the baseline landscape character of potential sites, and begins to shape what the landscape could become. Some initial design possibilities developed from this basic study are concepts like using fairways as meadows, greens as focal points or gardens, vegetative buffers as canopied trails, and bunkers as rain gardens;

ideas all of which are explored later in this paper. Concepts and Best Management Practices that are employed in commonly occurring scenarios can be carried across the network of sites as a way to continue the improvement of such installations through trial, error, and research. They can also act to tie spaces together thematically on a larger scale such as ecological restoration or community usefulness. Armed now with a deeper understanding of the basic components of the golf course, further research was then conducted on the history of the game to find out the social context in which this landscape was formed and how it functioned as such over the centuries and in contemporary society.

Chapter 2: Literature Review

Origin and History of the Game

The precise history of the games origin is debated, though it is generally agreed that the game started on the East coast of Scotland in the late 13th or early 14th century (Campbell, 14). "The earliest game on record was a match on Boxing Day in 1297 (King, 22). Robert Clark (x) speculates that the essence of the game— presumably hitting an object (probably a rock) with a stick to a target—probably developed in some prehistoric time. That seed of an idea was carried through history in a variety of structured forms that are 'cousins' to the game of golf like Croquet, Cricket, Baseball, and Hockey. Etymologically, there are two common theories of origin. The Scottish word 'gowff' meaning to hit, is one. The other is the Dutch word 'kolf', which originated from the German word Kolbe, translated to "Game of Club" (Clark, 2). The clunky image evoked by either name is an appropriate description of this early iteration of golf, as there was not much structure given to the game or the arena it was played on. But the context in which that basic activity of hitting an object to a target progressed is the story of the development and evolution of the golf course landscape.

History shows the game was originally played in the city streets with wooden balls, which created a great deal of havoc among the citizenry, as there was so much collateral damage caused by golf players (windows of houses and churches were broken, not to mention sometimes significant injuries to pedestrians) that city officials put new laws on the books to control it (King, 22). Subsequently, the game was played on shortly kempt rectangular turf fields managed by and for the archers and the targets were probably trees. Another historically early mention of golf was in 1457 when it was banned by the Scottish Legislature for interfering with what they deemed a more productive affair; archery, which was prized for its military value (Clark, 2). Both of these histories are expressive of one of golf's major disadvantages… it takes a lot of room to play. The courses therefore tend to cover large spaces separated from other activities. These evolutions were obviously critical factors in how golf would impact the landscape.

With the initial concept of the game established, it continued to develop over centuries. The routings (sequencing) of the early courses evolved through general agreement of the locals; those who spent the most time on the land. (Doak, 8). In this way, the first courses were discovered more than designed (Helphand, 74). They were established in vast open areas on the coast where animals and people roamed freely on the land, which was not suitable for agriculture or permanent dwelling. These 'common' areas are known as links lands (Campbell, 8). Over time, repetitive use of these spaces for

golf created patterns in the sand and turf that began to resemble golf courses as we know them today.

As golf expanded in popularity, players began to hone the landscape to better suit the game according to their needs. In the late 1800's this manipulation grew more pronounced with the Scottish influx into America, bringing more golfers and demand for courses—that, combined with the technology of new earth moving equipment that enabled unprecedented contour manipulation. This technological advancement ushered in a new era of design that sought to take advantage of new land and new techniques. As might be expected, golf as a game was greatly influenced by these developments, and changes in the character of the game lead to further changes to the golf course landscape.

The first mention of golf in the United States was 1786, in Charleston, South Carolina. Other mentions of the game in other states soon followed. It wasn't until over 100 years later, in 1894, when the USGA was established as an organizing body for the game in the United States. By 1885 there were 75 golf clubs in the U.S.; five years later there were more than 1,000 (Golf Magazine, 11). Many courses were formed by Scottish immigrants. Often, courses were chosen for their resemblance to the original linksland courses. Some even attempted to copy the holes of those courses as precisely as they could (Helphand, 75). These new manipulations and the subsequent evolutions of design led to unprecedented eras of golf course construction that has left a lasting impression on the landscape in the United States.

There are three distinct eras of golf course proliferation; the British links of the 19th Century; the classic design era of the worldwide golf boom from 1900-1930, and the post 1945 "modern era" of courses constructed with the aid of the bulldozer (Doak, 7). The latter two design eras are separated by the overwhelming social forces of the Great Depression and World War II. In the United States, by 1930 there were over 2,000 courses. Production slowed through the depression, and boomed after World War II. There were over 9,000 courses by 1980 and over 16,000 around the turn of the century (NGF, 2014).

There are also three generally accepted "Schools of Design" which contemporary architects often synthesize in practice, each having its own theories that affect the design, construction, and performance of the golf course. "Schools of design" are considered to have formed in the late 19th century. The Penal School came first, in the late 1800's. It sought to penalize any shot determined not straight enough or long enough. Then, in the early 1900's the strategic school of design emerged. A player on this type of course would benefit from playing like billiards, setting up the next shot. These courses were designed based on the original Scottish courses. The demand on both cerebral and physical skill became the goal of the strategic design school architects (Shakleford, 36-55). Lastly, there is the heroic school, where clear advantage is gained through carrying

(hitting the ball over) a large hazard (water/marsh/sand) from the tee box. (Shakleford, 46). The important concept here is that though each of these schools uses the same components (tees, greens, fairways, etc.), the way in which they are used differs, which has an impact on the overall character of the holes and the broader landscape.

As it relates to this project, School and style could have an impact on how some of the tees, fairways, topography, and hazards are laid out in relation to the green. The potential to use the strategic landscape to guide the flow of pedestrians through a space could be inspired or guided by these original design intentions. For the most part, however, these would just be minor differences when you consider the entirety of the site for repurposing efforts. It would affect the character of the site, the sequences, the relationships of different components in the landscape, but all of the golf courses are still made up of the same basic components.

In a way, the first creators of golf courses were amateurs in the field of site analysis as well as designers. They were designing real-time, while they played, determining the most receptive (or interesting) areas and plateaus for fairways and greens. They found the courses, in a sense; simply playing from start to end, avoiding the natural hazards in between. This unique aspect of the relationship between player and landscape has continued in some fashion even today. On some level we still design as players moving through the space in imagination and in practice. In a way, the game is used as a tool for design. Designers often make upgrades and changes years after the original construction of the course, after play reveals some previously unseen alternate design solution.

Allister MacKenzie, renowned architect of Augusta National, believes the reason St. Andrews (one of the original links courses) remains superior to any other course is that it was developed when nobody knew anything about the subject of golf course architecture (fig. 2.1). MacKenzie said “Beauty and finality must be provided for at the beginning”, speaking on how important it is to select the proper natural site for a golf course (Mackenzie, 75). There is an admission here, or a submission to nature, that is interesting to point out. He sees that we cannot dominate a landscape into efficiency; some spaces are better suited for certain activities… or certain activities utilize all the attributes of a space so to draw the full potential of the space out into the open. This indicates that the inherent landscape character is foundational to design, and speaks to the general quality of the landscapes that many golf courses occupy, which is an important aspect as it pertains to this thesis. Because of the character, location, make-up, and common landscape contexts of golf courses, these sites are worth preserving as some form of open recreational, community, or ecologically programmed spaces.

Figure 2.1: View of St Andrews from the Old Course, c.1740 (artist unknown)

Golf has a cultural history of being played by people of all classes. There are also records of woman playing for just as long as men, and a diverse patronage of old and young. The game was accessible historically because it was played on the commons, space shared by the community and their animals for other types of leisure, recreation and grazing respectively (fig 2.2). But golf also has a royal history, enjoyed by many significant members of the past British and Scottish royal families.

Figure 2.2: "The Golfers" by Charles Lee

Regardless of the history of golf as a game played by all classes, there is often a perception of golf as an elitist's game. The foundations of these perceptions might be born in some combination from the history of royalty playing the game, its association with centuries-old and wealthy social clubs, the country club culture of the mid-to-late 20th century in the United States, or simply even the average cost to play the game.

With respect to these stances, much of the history of the game of golf shows otherwise. "Golf was the sport of the people, and there appear to have been no social barriers among those who played. Royalty and commoners often played together. As proof, we may cite the first international match of record. Back in 1682, when the then Prince of Wales, later James II, was living at Holyrood, he engaged certain English noblemen in a controversy over the game's historic background and as an outcome challenged them to a foursome. He chose as his partner a poor Edinburgh shoemaker, John Paterson by name. The battle was staged at Links of Leith near Edinburgh. The prince and John were the winners. The Prince gave the winnings to the commoner who built a house with it which stood until 1961" (Golf Magazine, 3). This anecdote is indicative of social context golf course played historically. The prudent note here is that golf courses functioned as common public spaces filling vastly different roles than most contemporary golf courses, often lined with fences and evergreens for insurance purposes, functioning more like large private parks than the commons of the past.

All that being said, it's necessary to recognize the financially restrictive element that has been a relevant part of the game's history. The basic cost of golf equipment and access to reasonably priced courses are two issues of concern. Equipment was somewhat cost-restrictive for the first four centuries, until the advent of the gutta-percha ball in 1848, followed by the rubber core ball in 1902 (Browning, 135-142). Some could not afford the price of the early featherie-type ball, so golf favored the wealthy, though the cost was not high enough to exclude a great number of low and middle class golfers who made the investment. The aptly named featherie ball was expensive because it was difficult and time-consuming to make. It involved cramming a top-hat full of feathers into a tiny leather sack, then hand-stitching the seams. They were just too financially draining to replace for something so often lost in the high grass. But "The gutta ball, by making golf so much cheaper, created something of a boom in the game in Scotland" (Browning, 138). This popularity continued to grow and eventually spread out across the globe as the enthusiasts did in an era of global expansion. These, and further technological advances played a big role in the eventual popularity of the game and the subsequent proliferation of golf courses that has preserved so much of our countries green space amidst otherwise developed areas.

Today in the United States, however, clubs can be purchased at yards sales and pawn shops two-for-a-dollar and balls for a dollar a dozen. The larger problem is exposure, interest, and access to the game. In this regard, there are also more inclusive, less-

expensive options for interested golfers, like driving ranges, practice facilities, and municipal courses. Though access to these facilities can still be limited, especially in some urban areas, organizations like The First Tee and the USGA are making strides to increase access for kids of all socioeconomic levels in hopes of growing the popularity of the game in our cities.

Nationwide Inventory and Trends

Golf courses were built unsparingly throughout much of the 20th century, booming into the 1980's and 1990's. As previously mentioned, there are over 16,000 golf courses in the United States (NGF, 2014) covering about 2,400,000 acres. The scale of impact that a potential transformation of these spaces provides is enormous. Relevant to this study are the 100-200 golf courses closing annually in the United States, representing 32,000 acres of potentially new park or habitat space per year. As a group, they are supplying us with a large landscape inventory, spread out across the country, positioned to support the integration of regional character while addressing some collectively recognized ecological problems. They provide the opportunity to design a network of repurposed green spaces, parks, nature preserves, and resource conservation spaces that support the broader ideals of ecological stewardship and healthful recreation. They can become a mosaic composed of regionally specific design interventions borne on the local level.

Nationally there are 377,200,000 rounds of golf played annually, averaging out to 23,500 rounds per course (Golicz, 3). The industry as a whole generates an annual revenue of 76 Billion dollars (Martin, 10).This number had been climbing steadily until 2005, and 2012 marked the seventh consecutive year since then that golf course closures outpaced openings in the U.S. (NGF, 2013). Of the 800 closures in past decade, 93% were public courses (Golicz, 2).

There are three categories of ownership for golf courses, municipal, daily fee, and private. Municipal and daily fee courses are generally open to the public. This condition influences the users of a golf course. For example, municipal courses are typically more socioeconomically diverse, while private courses tailor to a more exclusive middle and upper classes.

In the majority of circumstances golf course are eventually developed residentially or commercially. In 2008 over 160 golf courses in the United States were converted to housing or other real estate purposes (Martin, 11). On the initial end of development, approximately 40% of current golf course construction is real estate related (NGF, 2014).This number doesn't include courses built or developed separately from houses that are nonetheless adjacent or surrounding the golf course. The NGF Domestic Golf

Facilities Database reveals that more than 1,400 golf facilities (some with multiple courses) have closed their doors permanently since 2001, part of a natural supply correction necessitated primarily by the overbuilding of the 1990s and early 2000s (NGF, 2014).

Golf courses tend to occupy areas of valuable real estate and are often integrated into suburban and urban development as well as being connected or close to some valuable ecological resources. In many cases they are quite literally in the middle of these two landscape types (fig. 2.3). The typical location, relative size, and ecological condition of golf courses contribute a great deal to their overall value and provide personal value to the people and communities around them.

It is important to keep in mind that approximately only one-third of those who purchase homes in golf developments play golf regularly (Crompton, 193). This is a clear indication that people purchase homes there for reasons other than golf. Golf courses are often connected to their surroundings through long views. There is an expectation that homes will always border or overlook an open green space, grassland, or woodland. This expectation can influence the amount of community support a repurposing project receives. These statements lend to the credibility of a project that looks at repurposing these spaces for both recreation and habitat; two things lacking in many of our developed landscapes. Considering the typical context of a golf course, one could speculate that a more inclusive recreational space could potentially serve a much larger percentage of these communities than the golf course ever did.

In fact, the idea of transforming golf courses from exclusive sporting landscapes to common recreational spaces brings with it many potential benefits. They preserve and transform valuable land, introduce new users and uses, enhance ecological value and appreciation, and provide potential for educational connections and engagement with nature. More specific to each; (1) the open, green space and mature vegetation of the golf course landscape can be used as a foundation for the restoration of key ecologies, (2) users other than golfers could access and use the site in ways they could not before, (3) they can provide increased ecological value through designs focused on ecosystem services, and (4) accommodate community exposure and educational opportunities through school programs, 4H, Boy Scouts of America, and other community groups.

Figure 2.3: Golf Courses in the Middle of Ecological Resources and Development

Cultural and Ecological Value of Golf Courses

The role golf courses have played in the past has been outlined partially in the history of the development of golf courses themselves. When evaluating the value and potential of golf course landscapes, it is important to answer the basic questions of what the landscape was and what the landscape wants to be. To determine these answers, the ecological and cultural values golf courses bring to their communities are necessary considerations.

In the United States golf courses are venues for multiple layers of social function. Matches with friends and family, coworkers, business partners, and strangers are all common occurrences on golf courses across the country on a daily basis. In addition to this, the clubhouses, restaurants, pools and tennis courts on many grounds often have a much broader social patronage than the golf course itself. Community events, weddings, graduation parties, birthday celebrations, anniversary dinners and picnics are often held in and around many of these facilities. Some courses even allow people to use cart paths

for hiking or dog walking, though this number is limited due to insurance and security concerns. In other words, though golf is the primary function of golf courses, they have generally played a much larger role in the communities they serve.

In regards to the existing value of golf courses, "The USGA determined that a golf course offers ten main benefits: Provides wildlife habitat, protects topsoil, improves community aesthetics, infiltrates water, improves health and reduces stress, improves air quality, captures and cleanses stormwater runoff, reduces pests, restores damaged land areas, and makes substantial contributions to the community's economy" (Conant, 91,92).

As mentioned previously, one basic function of golf courses specifically is how they preserve mature ecosystems in the form of vegetated space. "Many courses are, in fact, part of their community's green infrastructure' and are important segments of a community's water management systems" (Dodson, 68). Potential wildlife on golf courses include: Invertebrates, amphibians, reptiles, small birds, small mammals, large birds, fish, and other species. Those statements add additional weight to the argument to retain these spaces as some form of green or open space, as does the recent trend toward golf course sustainability.

On an organizational level, contemporary organizations like Audobon International and the Nature Preserve Certification Program are examples of continued attempts to limit our impact on nature, and cohabitate with wildlife in our recreational spaces. These organizations have a defined a set of baseline standards and work with property owners to establish wildlife sanctuaries on functioning golf course by increasing habitat value. Interventions are typically in out of play areas between holes, forest patches, streams, and wetland areas. The basic idea of decreasing human impact on wildlife and the environment is an increasingly important area of research that will influence future golf course repurposing efforts. Designing these spaces for wildlife habitat is a further manifestation of these basic ideas.

Audobon International is just one of many organizations who have similar goals including the American Society of Golf Course Architects, The European Institute of Golf Course Architects (EIGCA), and Eco-cert. All of these entities have contributed to creating ecosystem diversity and taking advantage of the necessary composition of the golf courses as a performance landscape to provide regionally strategic habitat.

The sustainability movement of recent years has increased habitat value on golf courses in other ways, as well. The conservation of open space in general has been an initiative of many cities in the last decade and golf courses can be considered a huge part of that inventory. On the site level, sustainability has impacted golf course design and maintenance in the form of lowered inputs of fertilizer, water, and general maintenance.

Naturalized, native grass areas are expanded to shrink the size of mown turf, and more suitable warm-season grasses are replacing cool season grasses, when the situation allows. Wetland areas are preserved and constructed, and wildflower meadows are planted in unused areas. A testament to the overall value of the golf course ecosystem is shown in a recent study that found golf courses had higher ecological value than comparable sites in sixty four percent of the cases. Control site categories for comparison included Parkland, Agricultural, Natural, Nature-Protected, Residential, Highly Impacted Urban, and Miscellaneous land uses (Colding and Folke, 194). Many golf courses also contribute to the preservation of fauna that are of conservation concern (Colding and Folke, 191).

In fact, the average golf course can support a wide variety of species. Ron Dodson (109) talks about some of the common species found on golf courses. Insects, reptiles, birds, and mammals can all benefit from a sound golf course ecosystem. Specifically, Bluebirds, turtles, frogs, white-tailed deer, and Canada geese are some of the most common species found on golf courses. Along with this, frogs are said to be a good indicator of environmental health due to the way they absorb water through their skin. Moreover, his recommendations for approaching frog habitat design can carry over conceptually through a wildlife habitat design, applying to habitat creation for many others species, potentially. He writes three keys; (1) make sure there are breeding sites available (2) make sure there are good habitats for adults and (3) provide safe corridors between the woods and the pond (Dodson, 111, 112). Matching these prescriptive methods along with other similar concepts is a key piece of this project.

Another way the ecological value of golf courses has been enhanced is by reducing their total land coverage. This can be accomplished by shortening the length of individual holes or the combined length of holes, reducing the total number of holes, and to a lesser degree through certain design techniques. The non-golf space can be used for habitat or some other recreational programing. In fact, not only has this concept of shorter courses been reignited in recent years because of constraints of time and space, but the idea of also harkens back to the original British links courses. Those courses varied in length, laid out more or less according to topography and availability of open space. Along with the short courses, others were longer than 18 holes. Saint Andrews for example was 22 holes, originally— really 11 holes played forward out, then backward (Langford, 12). This is a significant point that helped dictate the eventual size of our overstocked golf course landscapes. In 1764 St Andrews combined several holes to make one or two longer holes, which brought the total number of holes down 18. This number would become the golf course standard (Golf Magazine, 5).

Many golfers today see the number 18 as something that is unchangeable. If this attitude can change, and a golf courses length is determined instead by specific site constraints, course owners could potentially avoid some of the maintenance cost issues

they are encountering today. More to the point, the extra space saved by shorter courses could help create dynamic spaces for wildlife and recreation. Continued attraction of new players may be dependent on alternative forms for courses and equipment (Adams, 166). Michael Hurdzan said “there is absolutely no reason why golf can't return to its roots. Either shorter courses and/or fewer holes may be necessary to keep the game both affordable and interesting." There is a demand not only to have different length options, but various difficulty levels as well to provide for a more diverse user base.

As an example relevant to the larger practice of landscape architecture, the potential to use these sites to manage stormwater on a nation-wide scale could have a significant positive impact on the nation’s hydrologic condition. The network could be comprised of a combination of entirely repurposed golf courses in addition to those that are just shortened & expanded based on the fluxing popularity. This project focuses on courses being repurposed entirely, but the potential of growing and shrinking the golf course over time is another piece that could contribute to the overall success of repurposing these landscapes.

Grasslands are another important component to research in the case of golf courses. Obviously, if left to nature these grasslands would not remain static. “Absent grazing, mowing, burning, or other type of disturbance, grasslands will turn into uplands meadows and uplands meadows will revert to old fields. In turn, these will eventually grow into young forest and eventually to climax forest (Oehler, 1). This process is referred to as succession, and can potentially become a big part of the re-design of these spaces for wildlife habitat, recreation, and environmental education.

The adaptability of golf courses is exhibited more and more as golf courses close and owners have to decide what to do. Precedent examples include community parks, cemeteries, storm-water management areas, wildlife habitat preserves, and more. A recent study does well to outline in detail some of the possibilities of what a golf course could become. Through a detailed matrix, five beneficial possible uses were determined as agriculture, energy production, wetland treatment facilities, silviculture, and parks. Of those five, parks, silviculture, and wetland treatments were clearly ranked as the most beneficial for wildlife habitat (Conant, 92). Other potential repurposing solutions include trail systems, nature preserves, cemeteries, dog parks, amphitheaters, and sports fields.

In a conversation with Golf Course Architect Bill Love in 2015, his sentiment was that wildlife interaction, youth development programs, community inclusive programming, agricultural/rural landscape functions, and developmental golf facilities could all contribute to the success of an adaptive reuse project on a golf course. Using the clubhouse and other facilities as a community center, if possible, is another component he encouraged. These have all been a part of successful ventures he has seen in the past, which speaks to the versatility of golf courses as community resources.

Another question that needed further research for this project was the interconnected relationship of culture and nature, or more precisely recreation and wildlife; how one might impact the other and vice versa. Some frameworks consider these two systems as pieces of a larger whole, others as opposing forces. In any event, this bond is important to consider in this design. There is often a perception of a 'zero sum game' regarding cultural versus ecological systems (Haila, 337). But through good design it should be possible to consider better ways for our culture and recreation to be integrated with wildlife habitat. Golf courses are a good venue to showcase the integration of these two aspects because they have already functioned this way in some capacity as performance landscapes.

Nature and Culture

The integration of habitat and recreation is part of the larger conversation of the relationship between nature and culture. "We often believe that nature stands apart from- or transcends-social life, yet our experience of nature is profoundly social." (Jerolmack, 501). Not only are our experiences and memories filtered through a social lens, but culture is often expressed manifestly through the landscape; an expression that makes landscapes dear to us because we feel like a part of them. If we can continue to re-examine our view of this relationship in consideration of our role on the planet as a piece of the larger whole, maybe as a society we will be more apt to find value in the natural environment and to take care of it.

There are several prudent examples illustrating cultural impacts on landscape. The most pertinent example is how golf courses developed over hundreds of years as cultural relics impressed upon the landscape that later spread along the trail of the games growing popularity. The form and shapes of the golf course landscape, as described earlier, reflect a cultural (recreational) history. Another regional example is how the picturesque aesthetic of the 18th century in some parts of Maryland was a manifestation of the eastern farming culture. The geometric fields, clear cuts, long views, and patches of forest, are all components of this functional aesthetic. They show an efficient survival history based on property lines and production. Both are clear examples of how culture can impact nature.

On a broader level Kongjian Yu talks about how the struggle of survival in ancient China manifested itself over thousands of years in the landscape patterns that showed a balanced relationship between man and nature. He wrote that "The skills of survival reflect the authentic relationship between the land and the people, and it is this authentic relationship that gives the culture and the people its identity" (Yu, 29). In a sense, people are connected to the landscape because it retains some deeper value than landscapes that

have no connection to cultural history. Landscapes that express the history of the land in their form and character are meaningful in a way that decorative or arbitrary designs fail to capture.

J.B. Jackson was one of the first writers to articulate the important connection between landscape and culture in the U.S. (Gieseking, 259-262). Up to then, in the United States, many designs were framed around a desire to tame nature, or to dominate it, rather than to work *with* it. However, many contemporary landscape architects continue to evolve their designs through a lens that views humans as a part of nature, and are stewards of the lands they manipulate.

The notion of 'man as nature' has much in common with what is now termed sustainability. "In today's terminology 'unity of man with nature' means that human activities should be integrated within natural patterns and processes so that harmony between man and nature can be achieved" (Chen, 1017). Everybody is essentially saying the same thing: 'living with nature, not separate from it, is the essence of unity with nature'. "We don't have to turn it into a spiritual Gaia or Goddess to see the world as a single one, we just need to question systems that confine agency to a human or human-like consciousness and refuse to acknowledge the creativity of earth others, whether organized into a single system or not" (Plumwood, 117). Regardless of the words used to define it, the prevailing thought is that nature and culture are invariably intertwined, and therefore need to be looked at as a system in order to protect the interests of each, and the whole.

The integration of recreation & habitat involves complex systems of ecologies and patterns of human nature. Certainly humans have interacted with wildlife in various forms throughout history in nature, agriculture, hunting grounds, zoos, or through activities like birding and fishing, or even painting, or photography. But as the environment and human cultural needs change, research in these areas continues to be important to inform design. This thesis considers theory on design of habitat and recreation, as well as consideration of how they will come together.

Wildlife Habitat and Recreation

"In its most basic form, habitat is where a species lives". Habitat can also refer to a geographic space or a conceptual space. It may refer to the area a species occupies or to a set of biophysical conditions necessary for the species' survival. And it may refer to a species' historic range, potential range, or current range (Alagona, 433). The word habitat came into common use during the eighteenth century. Naturalists adopted it from the Latin form habitare, which referred to a 'natural place of growth or occurrence of a

species' (Alagona, 434). Habitat in the case of this project is considered as a place a species lives as well as a set of biophysical conditions necessary for the species' survival.

Diverse habitats have a number of characteristics that make them particularly suitable for many species. On the ground, a large portion of "available urban spaces for restoration actions are often scattered, surrounded by the infrastructure of modern life: our roads, residences, and commercial districts. The available spaces are landscape islands in a sea of development" (Handel, 169). This idea frames golf courses as being particularly well suited to be repurposed as ecological preserves. The landscape patterns can be seen in suburban and rural areas, though to a different, or lesser degree. The simple fact is that drastic and swift human impacts have made it difficult for many other species to thrive because they are not equipped to live in the fluctuating conditions of the environment.

In terms of the broad character of the ecosystem, the patch and corridor mosaic dominates the landscape in the United States. This characteristic is obvious in many aerial photos of our region that reflect particular geometries, patterns, and networks. Deforestation, agriculture, development, and roads, all developed under the guiding force of property lines, are responsible for the shape and form of the region and the resulting impact on the natural ecosystem. Wildlife habitat has suffered because of this. Residential streets, feeder streets, commercial streets, strip malls, regional malls, and industrial parks are all notable patches in the suburban landscape that impact the ecology (Grimm et al, 578). In addition to these components, the rural landscape is often impacted significantly by agricultural practices. Regardless of the type influence, these patterns generally increase the number of edges in a given landscape, which in turn drastically changes the ecology.

Edge habitat, while valuable, depends on other ecosystems to counter and can promote the growth or population of invasive plant and animal species. Because of this, developing a landscape scale plan that delineates a biologically sound pattern of patches and corridors is essential first step in planning for wildlife (Johnson, 224). Additionally, as a general note, one larger area of group habitats is better than a few separate habitats (Colding and Folke, 204). But in lieu of large contiguous patches of forest, a solid corridor and patch network provides many species access to the landscape ecologies they need to survive.

'Recreation' is defined as; (1) Something people do to relax or have fun: activities done for enjoyment (2) Refreshment of strengths and spirits after work (3) A means of refreshment or diversion: hobby. The first definition is probably the most commonly used. It frames recreation like it is rooted in easy pleasure and enjoyment, leisurely strolls, and laying around in a general state of ease and rest; the main theme being a condition of happiness. This is certainly an important aspect of recreation. A broader

interpretation of these definitions includes exercise for physical, mental, and spiritual afflictions that have the potential to be treated through recreation. The therapeutic implications here are important to the framework of this design. The third definition includes activities that are done for the sheer reason of distraction, or to fill time. This definition invites us to play, and to be irreverent. The common theme of all of these definitions is that recreation is generally a broad category of ways people choose to spend their time when they are not at work. The combined depth of all three of these definitions illicit thoughts of a wide range of recreational programing options.

Additionally, the increasing issues we have in the United States with obesity and related health issues continue to demand attention in the types of spaces we design and create. These larger public health issues combined with the location of many golf courses that are integrated within suburbs and cities make them valuable as potential recreational spaces. In many cases within a few mile radius' there are schools that could use the spaces for environmental education, hospitals that could use them for therapeutic programs, or churches or community centers that could use them as arenas for personal & spiritual development.

Regarding habitat design on a conceptual level, "The literature shows two types of design approaches that have been explored for protecting or restoring habitats: the landscape-specific approach and the organism-specific approach" (Wang, 1). The organism specific approach targets certain species and builds the characteristics of a habitat necessary to support those species. The landscape specific approach is a broader style approach that focuses on building certain landscape ecologies and vegetation to support a range of species. Within these categories there are more specific approaches such as designing for Keystone Species whose unique connection to the environment through their impact on the community is disproportionately large relative to their abundance, which makes them important to the ecosystem at large. There is also the focal species approach; identify threatening processes responsible for species decline and select a 'suite' of species (Wang, 2-18) to design for.

To design quality wildlife habitat requires a depth of knowledge about specific habitats and larger ecosystems. The importance of the ability of researchers to be able to access, analyze, and use a single set of plans that cover a large geographic area is key. GIS and Statewide Action Plans (SWAPS) fill this role, and both play a role in this thesis design. On a broad scale references present an opportunity to consider the landscape condition of the entire country (Lacher and Wilkerson, 13), which would be useful information for golf courses looking to impact the environment in a more significant way.

Phasing and scale are also important factors in habitat design. The tempo of successful woodland restoration is slow (Handel, 171). Phases of planting and implementation of other site attributes help protect new species and promote succession. In addition, the

targets of biodiversity need to be designed for at the appropriate scale needed to make the desired impact. In regards to the scale of wildlife management areas, golf course sites are in the category of 'Natural Fragments' (Ginsberg, 49). The typical 100-200 acres covered by most golf courses is enough contiguous space to make a significant impact on the landscape and potentially provide niche habitat for threatened species. For example, some larger species of birds of MD require 80 or more acres of contiguous grassland in order to be suitable long-term habitat, which some golf courses would be able to provide. Open grassland areas in particular could be addressed through golf course retrofitting because of the spatial and vegetative qualities of golf course fairways. The open nature and large size provides enough space for transition from one ecosystem to another and to allow an ecological continuity to be built into whatever landscape the golf course becomes next.

One opponent of continuity is boundary. Boundaries are a large part of the history of our development in the form of property lines, fences, trees, and roads. As mentioned previously, they are the driving force of the patch corridor mosaic. And on a personal and cultural level boundaries can negatively affect our ability to interact freely with nature (Fall, 249), an interaction that is at the heart of this project. Spaces should not restrict our interactions with nature, rather encourage them, and guide them in cases where separation is necessary. They should be variably permeable and unobtrusive, inconspicuous, or false, edges and limitations should be blurred.

Physical limitations are another consideration. It goes without saying that providing access to people of all ages and ability will help fulfill goals of serving a diverse user base. Designs need to balance this with theories that challenge it, like how "the practice of skill presents unrealized opportunities to pursue an ecological approach within the context of sustainability" (Mullins, 132**)**. Golf is a good example of this theory coming in to form; basic skills are acquired, perfected, with the potential culmination of a professional golf career where you play the best courses in the world. On a broader recreational scale, there is a perceived activity-environment tension, of skill versus environmentally focused activities, which does not have to be the case. "Canada blurs this tension by requiring skill to travel historically and ecologically rich routes" (Mullins, 134). While consideration of serving and accommodating a diverse user base in regards to ability and skill level is a necessary part of any good design, this aspect of the requirement of skill as part of some experiences can work well with the need to control high activity in certain zones in designed wildlife habitats.

Regardless of the ultimate design decisions, the more useful and integral a habitat space can become to a community, the more chance it has at success. Habitats become reality when they reflect local values and are supported by a large cross section of the community (Johnson, 219). Reflecting local values in the landscape through designed program and form could help garner that basic support. Understanding the history of the site can help inform those design strategies.

As mentioned in the previous section, when designing habitat, consideration of the behavioral needs of the wildlife and how human activities might impact habitat suitability is critical. In the article 'The effects of non-consumptive wildlife tourism on free-ranging wildlife: a review by Ronda J Green and Karen Higginbottom (185) they discuss the many factors affecting the likelihood or severity of disturbance to an animals, as well as many other references for this information. Some of these ideas include effects of partial or total clearing, fragmentation, modification of habitat, or replacement of native plants. Some additional design considerations that most affect wildlife, for the means of this study, are the openness of habitat in which animals are seen, predictability of movement, and the height of habitat above the ground-plane. Other considerations are the size of target species (e.g. small birds are more tolerant of disturbance than large) and mitigation of noise disruption of foraging or parental behavior.

The book Wildlife Recreationists (Knight and Gutzwiller) also details the intricacies of integrating recreational programming into wildlife habitats, and was an invaluable source for this study. Many of these ideas are foundational to the success of any habitat design, and are concepts and theories that are triangulated through research. With the bevy of information about how animals react to human contact, it was possible to gleam tangible prescriptions for how one would go about designing a landscape capable of promoting the integration of wildlife and recreation on a former golf course landscape.

The number of users of a given landscape and the frequency of use combine to account for overall intensity of use. In regards to intensity of use, there are several ways to limit impact. Recreation should be focused, limited, intermittent, predictable, and at noncritical times, i.e. nesting, foraging, and migration. It also makes a difference whether the disturbance is motorized versus non-motorized, air versus ground-based, localized or widespread. Speed, predictability, frequency, timing, and location of the disturbance all matter. An increase in the number of users does not have much more effect, studies show, so long as the length and amount of use is similar. (Knight and Gutzwiller, 1-335).

Specific to animal behavior, there are several items to note that were incorporated into the overall design framework for this project. Larger animals flush (scatter) at a generally greater distance; this could influence the types of animals best suited for this kind of landscape as well as the design of the integration of recreation and habitat. Undulations potentially provide sound mitigation for smaller species; contours of the golf course could be used, accentuated, and multiplied to provide more conducive habitat for these creatures. The more ground-level disturbances there are, the higher the birds tend to be in the canopy; nests and roosts could be designed in areas where there is high ground disturbance to provide birds places to escape too in the canopy. Fish and mammals can sense direction of approach, and fear direct approach, so trails can be made to tangentially approach high value wildlife areas. (Knight and Gutzwiller,1-335).

Other tactics are designing clustered areas for active human use which helps save habitat space or minimizing roads and parking to reduce fragmentation and disturbance. One article specifically recommends that “roads and parking areas minimized and placed at the periphery of the site, all recreational and environmental education facilities configured in tight clusters and located on sites of limited habitat value” (Johnson, 223).

This more targeted review of relevant literature on wildlife and habitat broadly outlined the multi-faceted considerations necessary for golf course retrofitting projects and designing for the integration of habitat and recreation. The theories, concepts, and tactics were influential in constructing the basic framework for the final design. Using this broad knowledge base as a foundational guide, the next step was to study precedent examples that could inform the design.

Chapter 3: Case Studies

Based on preliminary research and concept development, two former golf courses sites were selected for further review as case study precedents for this project, Acacia Reservation and Orchard Hills Park. The sites are comparable in many ways, most notably having an overall goal by project owners and principles to guide site succession in some fashion in order to promote a more ecologically healthy landscape. The extensive masterplan for Acacia Reservation was reviewed for pertinent information, and a site visit and photo log was conducted for each site. The visual information gathered during these sites visits, as well as the documented strategies and tactics used in these designs were invaluable to the development of this project, especially concerning ecological restoration and forest succession.

Acacia Reservation, Cleveland, Ohio

Acacia Reservation is a 155 acre site in Cleveland, Ohio that functioned as a golf course for over 100 years before being converted to an Ecological & Wildlife Preserve in 2012 (fig. 3.1). It is part of a larger network of parkland owned by Clevelend Metroparks that covers 22,000 interconnected acres sprawled out through the city, referred to as an "Emerald Necklace". The golf course was built in 1921 using the common means of the time; drainage improvements, minor grading, soil amendments, pest and vegetation management, and irrigation practices. Cart paths, maintenance facilities, and the clubhouse were other notable features of the site. The golf course was built and modified over time by the many different caretakers, so there is no comprehensive master plan available that accounts for the precise landscape conditions.

The watershed of Acacia is home to about 60,000 people living in fairly urban conditions. Acacia is bordered on all four sides by 'development' thus making it a 'patch' in landscape ecology terms. Taking the existing ecological and spatial conditions into account, as well as the needs of the greater Cleveland Metropark system, Acacia Reservation was envisioned as an ecological preserve and an open space oasis. (Cleveland Metroparks, 3).

Specifically "The Ecological Restoration Master Plan for Acacia Reservation sets out a process and path to restore the former Acacia Country Club to an open space mosaic of forests, wetlands, streams, open water, and meadows to provide residents the opportunity to reconnect with nature" (Cleveland Metroparks, ES 1). Acacia Reservation was "envisioned as a robust forest, dominated by native hardwood species, with a rich understory that provides improved structure for wildlife" (Cleveland Metroparks, ES 1).

The master plan lists several ecosystem services that would be provided by restoring the golf course landscape including flood and erosion reduction, groundwater recharge, carbon sequestration, climate regulation, areas for aquatic habitat, purification of water and air, seed dispersal, food sources for native wildlife, pollination, honey production, and pest control, as well as stop-over habitat for migrating birds. There are six priority habitat areas that have been identified for consideration in the master plan; streams, forests, ponds, wetlands, meadows, and green infrastructure applications to developed areas of the site. Those involved wanted to restore the property to a 'natural state' and do so in a way that would encourage public access and stewardship. They also wanted to protect the watershed, and create a landscape consistent with the rest of the Cleveland Metropark system. They hope to maintain the known uses of the site other than golf, like fishing, hiking, jogging, bird watching and seeking solitude, as well as support additional 'passive and low impact recreational activities'. (Cleveland Metroparks, 2).

Figure 3.1: Acacia Meadow Ecosystem

The conditions of the sites natural resources, though plenty, were degraded due to impacts of urbanization and development. The associated floodplain was compromised and the impact on the stream was significant. Some issues regarding water quality on Acacia were flooding, loss of headwater streams and tributaries, decreases in overall water quality, loss of floodplain, erosion and sedimentation, channelization of the main

stream and tributaries, lack of habitat within the creek and along its buffers, urban runoff, sanitary sewer overflows, illegal dumping, and loss of green space. (Cleveland Metroparks, 4-7).

The "two overarching ecological goals for the site that drive the restoration plan were 1) reconnecting the shallow groundwater and surface water wetlands and streams, and 2) transitioning the vegetation across the site to a diverse mosaic of open meadow and forest communities overlain on the restored site hydrology" (Cleveland Metroparks, ES 3). The site had wooded areas, but they were generally fractured and not indicative of a quality forest canopy for wildlife. Natural processes had already taken over in some places, but if left to their own succession they would likely develop many invasive plants and continued homogenization.

The overall hydrologic situation was not ideal. During construction pipes were used under the fairways to move water to the margins of the site. This is an aspect typical of many golf courses in order to keep water off of the fairways for better turf growing conditions and playability. Various techniques are used to accomplish this including sub surface drains, pipes, swales, and in some cases, drainage tiles. Tile drainage was an issue at Acacia Reservation (terra cotta tiles placed by hand butted against each other or with a small gape) and was said to represent a negative legacy impact to the site hydrology. In fact, this is the opposite of what would be considered an ideal hydrological situation, which is to hold water initially closer to where it lands and let it drain more slowly over time, to promote wetland function and groundwater recharge, and filter runoff through plants and soils.

Specific Restorations strategies for the project included stream restoration, buffer enhancement, seedling regeneration, stream daylighting and hydrologic restoration to headwaters and tributaries, pond fringe enhancement, wetland hydrology restoration, fairway to native meadow establishment, moist to wet meadows as transition habitats, among others. Other strategies include active plant installation, protection and management in some areas as well as managed natural succession in other areas. The plan also suggested use of an environmental artist for deer/plant enclosures (Cleveland Metroparks, 28-48).

Techniques for stream restoration include channel invert fill to reduce incision and provide floodplain flow connection, and the use of berms and pools to hold water and manage the release. There are also plans to use material found onsite to help modify stream including rock and log vanes, root wads and woody debris, and native riparian plantings. The report recommends starting up stream with restoration efforts because it might be beneficial to see what the effects are before continuing downstream (Cleveland Metroparks, 28-48).

The broader hydrologic restoration plans call for a mosaic of forested wetlands (floodplain, swamp, vernal), wet swales and wet meadows (fig. 3.2). The areas with poorly drained soils on site, groups C and D were nominated as good places to reestablish wetlands and associated eco-tones. Specific pond treatment strategies include restoring fringe wetlands, establishing wetland benches, using cut and fill to improve the littoral zone and the vegetative buffer, slope stabilization, edge plantings, floating wetlands, peninsular projections into the pond, and framed views from trails or elevated walkways that keep visitors from getting to close to the pond. The restored edges on the pond margins will support shallow water emergent and submersed plant beds, and shrub wetlands capable of supporting greater fish, amphibian, reptile and bird use. In some site situations, "replacing the piped outfall with an ecologically engineered base-flow channel would create wetland and aquatic habitat, improve water quality, reduce slope erosion, and improve park visitor aesthetics" (Cleveland Metroparks, 34).

Figure 3.2: Common Hydrologic Opportunities

Another important part of the Acacia plan was converting some fairways to native meadows. In regards to this transition, the report states that "conversion of existing landscapes to native meadow can be broad scale in the short term, to be cost effective and aid in the transformation of soils and hydrology, and can later be reduced in scale to selected areas to move the system to a more complete forest cover" (Cleveland Metroparks, 40). The golf course grasses were mainly fescue and bent, "and are not high value habitat for wildlife, particularly not for pollinator species or birds, but they do

provide many opportunities for 'prairie' or wet meadow restoration to promote habitat diversity and a potential transition for future forest habitat" (Cleveland Metroparks, 40). To aid in this transition, the plan recommends appropriate herbicide treatments to kill turfgrass, and allow the drill seeding of native meadow grass species, and using a sub-soiler in selected areas to rip and loosen compacted areas. Other techniques for meadow establishment and management include tilling, selective small-scale planting with native plugs, establishing seed donor collection areas, periodic mowing, and invasive species management of meadow invaders. Specific techniques mentioned for reforestation include release or transplant of regenerating seedlings, buffer plants of native container-grown plant stock (could be grown on site), and protection methods like temporary fencing, herbicide, and physical plant removal (Cleveland Metroparks, 41).

The masterplan also mentions concerns of possible discontinuity of soil horizons (about 8 inches down) from the decades of management typical of golf courses, especially the longer the course is established (Cleveland Metroparks, 11). On that point, this is one difference between Acacia and the site that was eventually selected for this project; while acacia was almost 100 years old, Wakefield Valley was a golf course for just a little over 30 years. Being a highly manicured ecosystem in general, this length of time could have a big impact on the on the health of the ecosystem.

The possibility of designing in phases was also discussed in the plan. Project managers hoped the plan would be a living document based on changes in funding, ecology, support, involvement, and unforeseen issues and circumstances. These hopes are encompassed in the adopted long term management philosophy. "Adaptive management is a tool and process used to cope with the inherent changes and uncertainty fundamental to natural resource management, the ecological process that encompass them, and potential changes in goals, intended outcomes, support and available funding over time. Even if funds and capacity were limitless, it would be advisable to carefully transition from the current condition to the desired ultimate project condition." (Cleveland Metroparks, 65).

Finally, the report also discusses information gaps in the project including the need for more flow monitoring, measuring groundwater levels, park funding details, preferences for removal of irrigation, preferences on long-term forest cover, and deer density. Also, "A more complete understanding of how the ponds are interconnected would be helpful to pond rehabilitation." This being the case "opportunities for research and monitoring collaboration with local universities and high schools abound; investigating the effects of climate change, as well as studies of wildlife use, soils, succession, hydraulic change over time, and vegetative provenance" (Cleveland Metroparks, 68).

The Acacia Reservation Masterplan also lists several similar precedents. These include Salem Golf Course and Ponderlodge Golf Course in New Jersey, The Forest

Beach Migratory Preserve in Wisconsin, and Orchard Hills Park, in Ohio. Based on a topical review of these sites, Orchard Hills was the other case study I selected and reviewed for this project (Cleveland Metroparks, 4).

Orchard Hills Park

Orchard Hills Park is a 237 site, formerly a golf course, converted to habitat and recreation area in 2008. Having similar design intentions to Acacia, but being 5 years further along in the implementation process makes this case an interesting study for comparison. The stated mission of the project is to preserve and protect the natural features of Geauga County, Ohio and to provide the opportunity for people to enjoy and appreciate those resources.

Habitat restoration is taking place over a period of time to return to property to forest, meadow, streams and wetlands. Each year, one fairway is planted with young seedlings for reforestation. In addition to several open pavilions of varying size, gravel trail construction took place in 2011. The park is now popular for walking, running, cycling, cross-country skiing, birding, photography, and many other active and passive recreational activities.

Similar to the Acacia Reservation Project, Orchard Hills Park employed stream restoration and associated pond dam removal, stream bank stabilization, headwater stormwater non-point source control and bio-swales, riparian wetland restoration and creation including vernal pools, open water and emergent wetlands, sedge and grass wet meadows, and forest restoration. One significant difference in this site and Acacia Reservation is that Orchard Hills is much more rural in character, with better possibilities for patch and corridor connections.

Since the process of reforestation and managed succession began in 2008, the spatial character of the landscape differs significantly from Acacia Reservation. The formerly open fairways at Orchard Hills are now filled in with pioneer species grasses, shrubs, as well as trees planted 1-7 years ago. These species, Oak and Maple primarily, represent the guided succession at various stages of development. Instead of trails through wide-open spaces some 200 feet or more, there is a greater sense of enclosure when walking on some segments of the trail.

There are obviously many specific design strategies from both Orchard Hills and Acacia Reservation that could be applied to a project of a similar nature. The following images show some of those commonalities (figs. 3.3-3.6). They include repurposing cart paths as trail systems, maintaining secondary trails for exploration, establishing layered understories and forest edges, and reforestation and fairway to native meadow conversion.

Figure 3.3: Cart paths repurposed as trail systems

Figure 3.4: Secondary Trails and Strategic Viewing Areas

Figure 3.5: Layered Herbaceous Understory

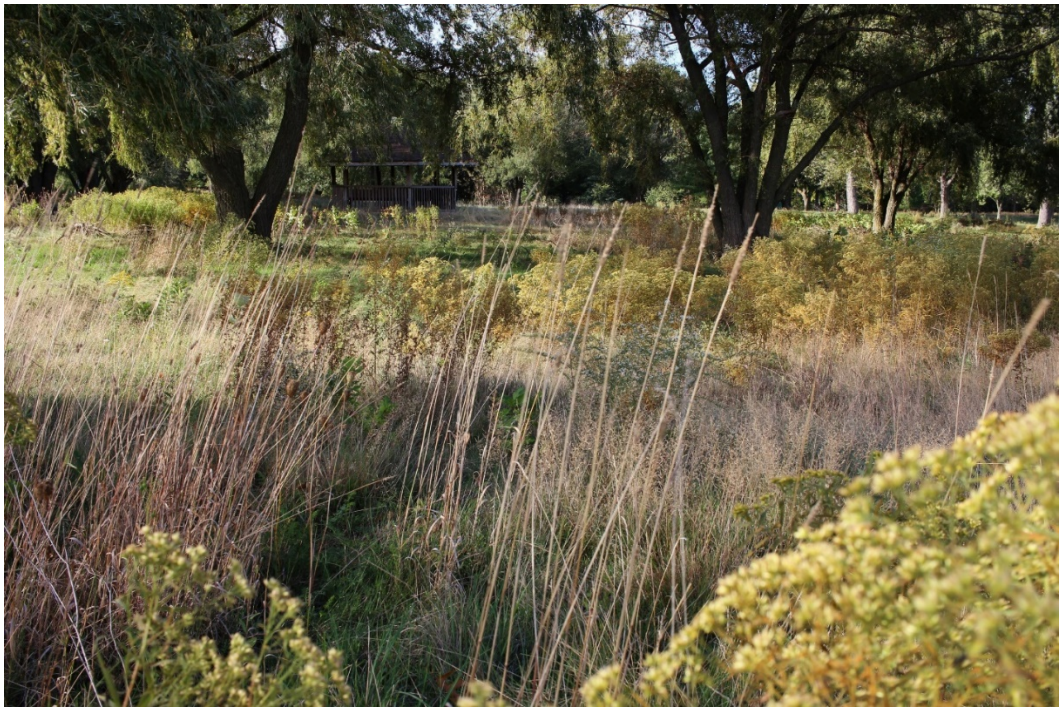
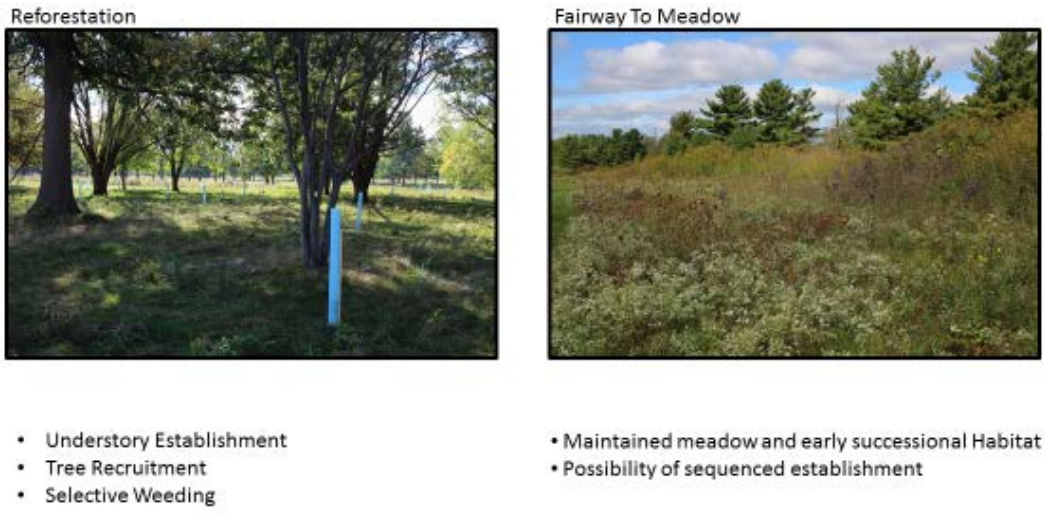


Figure 3.6: Reforestation and Native Meadow Establishment



Chapter 4: Site Selection

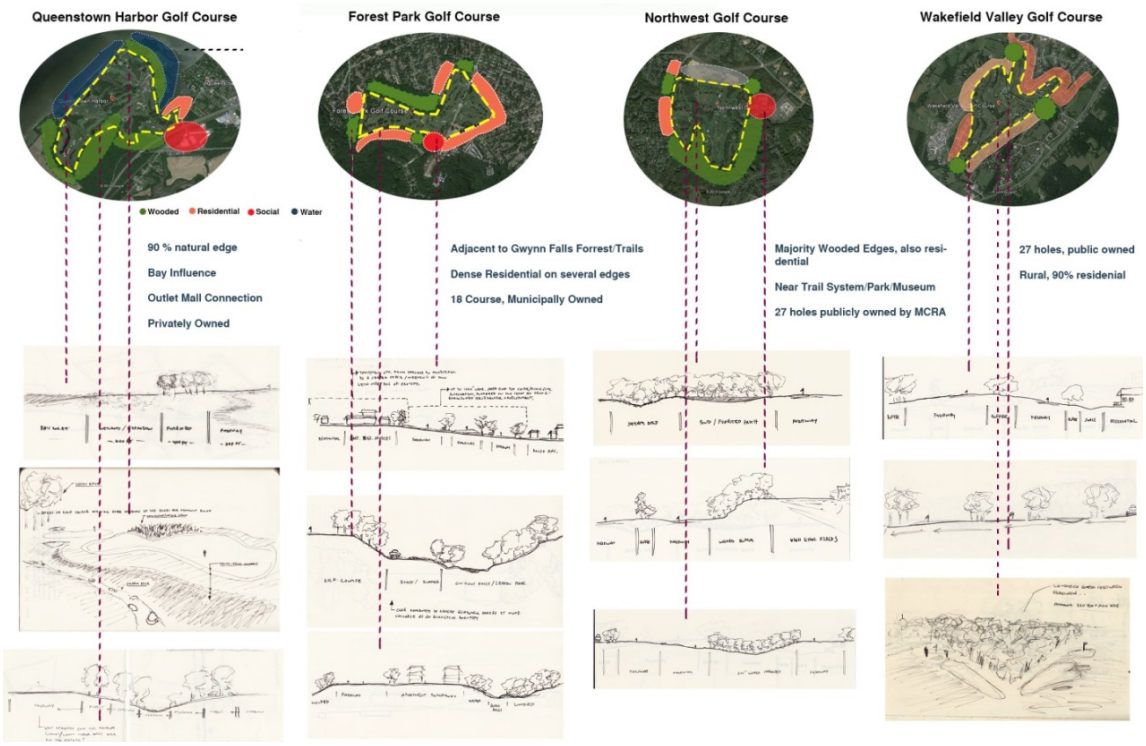
Maryland has a diverse golf course landscape. There are mountain golf courses in the West, coastal courses in the East, and the courses in the rolling hills of the piedmont in between. There are about 220 courses in Maryland and The District of Columbia combined, totaling some 35,000 acres, the majority of which are in the Eastern half of the state.

Site research and analysis was conducted on several golf courses in the region that vary in age, context, and overall success. It was easy to find several sites that were closed or being considered for closure. Golf Courses included in some portion of the studies were Wakefield Valley Golf Course, Marlborough Country Club, Sligo Creek Golf Course, East Potomac Park Golf Couse, Northwest Golf Course, Forest Park Golf Course, and Queenstown Harbor Golf Club. In addition to various studio exercises to determine the best site for this project, site visits also played an important role in the site selection process.

Figure (4.1) shows a typical edge analysis conducted for some of the golf courses researched for the project. This exercise conducted to accumulate more information on specific site context and to continue to develop the framework for what the ultimate design could be. Both Forest Park and Wakefield Valley have housing around much of their borders, though it is much denser around forest park, and Wakefield valley is in a more rural landscape with larger housing lots. Some other typical golf course characteristics near several of the courses are patches of forest or large open fields, tree-lined, parallel fairways, elevated plateaus, and stream valleys. These characteristics all played a role in the ranking of the course in the site selection matrix discussed later in this section that was developed to assist in the site selection process.

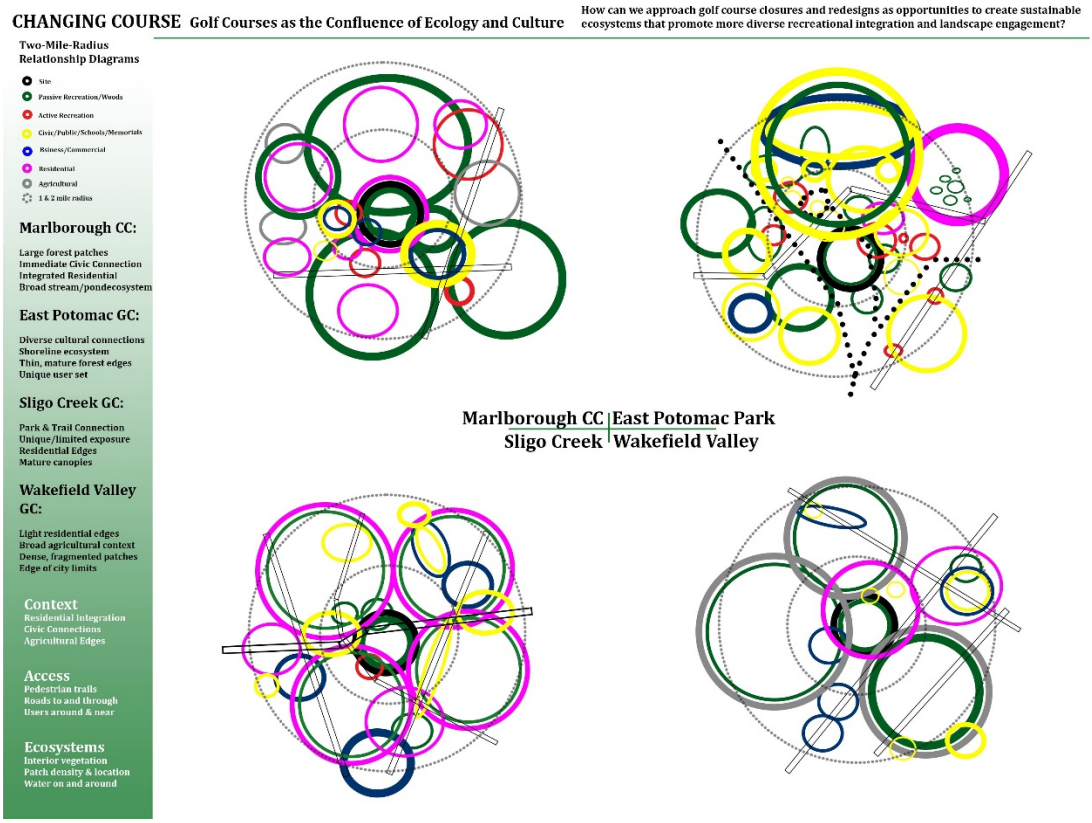
After consideration of the immediate edges of the sites, a review of their broader contexts/adjacencies was conducted using radius diagrams (fig. 4.2). The surrounding landscapes were represented on a basic circle diagram to get a simple visual representation of the context of each site. Circles of varying color and thickness represent various land uses and densities. For example, Wake field Valley, the site eventually selected for this project, shows through the large gray circles around most of the diagram that the region is dominated by agriculture, in addition to having a rural/suburban housing developments immediately around the courses. Within the city limits of Westminster Wakefield Valley sits between a relatively populated area and a landscape dominated by farms, houses, and the familiar patches and corridors of forest discussed earlier in this paper.

Figure 4.1: Edge Studies



Regarding some of the other potential sites, the potential of East Potomac Park as a culturally integral space became apparent through radius diagram because of its location amidst all the established cultural locations around the National Mall. However, it was not selected in the end because of the golf course facilities success, and the future plans for it to be redesigned into a championship 18-hole golf course. Marlboro Country Club also had wonderful potential to be connected to the civic center and already has an established wetland trail system. Sligo Creek is a 9-hole course in Montgomery County surrounded by relatively dense housing and commercial development. Its lack of success and popularity as a golf course has left it vulnerable to closing and redevelopment over the last decade, though nothing has been finalized due to protests of certain citizen groups whose aim it is to keep it as a golf course. The context of these courses, all within relatively small area, exhibits the rich potential golf courses have as habitat zones and integral cultural spaces. These exercises solidified the evidence that these are the two values that should be conserved and evolved when repurposing these sites.

Figure 4.2: Radius Diagrams



After these analyses of the potential sites, and visits to each, a basic matrix was established to aid in selecting the best site to exercise the ideas adopted and generated in this thesis. In total, eight courses were rated in four fundamental categories; status & success as a golf course, amount of available land, environmental resources & ecosystem connectivity, and cultural context (table 4.1).

Table 4.1: Site Selection Matrix

	WV	MCC	Sl. C	NW	RCP	EPP	QH	FP
Status	5	5	3	1	3	1	1	3
Acreage	5	3	1	5	3	3	5	3
Ecosystem Resources	3	5	3	5	5	5	5	3
Cultural Connection	5	5	5	5	5	5	3	5
	18	18	12	16	16	14	14	14

Each category is described here in further detail. First, the Status Ranking of the golf course is a consideration of whether the site is likely to remain a golf course in the future. The higher the number the better the chance the golf course has of being repurposed. Wakefield Valley is currently closed, and will not be a golf course in the future according

to the City of Westminster. Courses like Sligo and Rock Creek Park are scored in the middle here because there have been discussions about repurposing these spaces in the past, but they are likely to remain golf courses, at least in the short term.

Regarding acreage, the larger the parcel of contiguous land, the more opportunity the site has to impact wildlife habitat, all things being equal. Therefore the larger spaces were ranked higher in this category. Wakefield Valley's 27 holes provide 244 acres of space, whereas Sligo Creek scored lowest in this category as a 9-hole 60 acre golf course.

Broad, regional and adjacent ecosystem context also make a difference in the value of the space as potential habitat. The ecosystem resource ranking is a measure of on-site vegetation, patch and corridor context, water resources, and general ecosystem quality. Wakefield scored average in this category as an important water resource with many acres of mature vegetation, but lacking some of the potential to connect with larger neighboring patches of forest.

The connection potential is a ranking of general social context or relevance. All of the sites have potential to be integral cultural spaces to their communities and achieved high rankings in this area being near trails, parks, preserves, civic and cultural spaces, and more. This is another point for the case of golf courses as good spaces for park and preserve repurposing efforts. The only site that did not score well in this category was Queenstown Harbor which has no housing developments surrounding it, is removed from any significant population, and is accessed through just one two lane highway with no extensive pedestrian trails.

Based in part on the results of this matrix, Wakefield Valley was selected as the focus site. Not only did Wakefield Valley (fig 4.3) score the highest overall, but most prudently it is planned to be transformed into a park and already has momentum as a project. It works well as a site for this thesis because of the large acreage, proximity to existing pedestrian traffic, potential as a habitat, and aesthetic value, among other reasons.

On a broad level, the character of this site alone makes it an interesting site for this project. The rolling hills, streams, scenic views, and mature trees characteristic of the piedmont provide a diverse setting and a unique opportunity (fig. 4.4). Visually the regional landscape exhibits broad sweeps of colors and textures, angular borders in the form of fences, plantings, or roads, and a variety of open stretches of grass bordered or framed by mature trees. Specific to Wakefield Valley, there are wetland areas, ponds, streams, deciduous patches, and pine forests than provide an existing armature for ecological restoration design strategies.

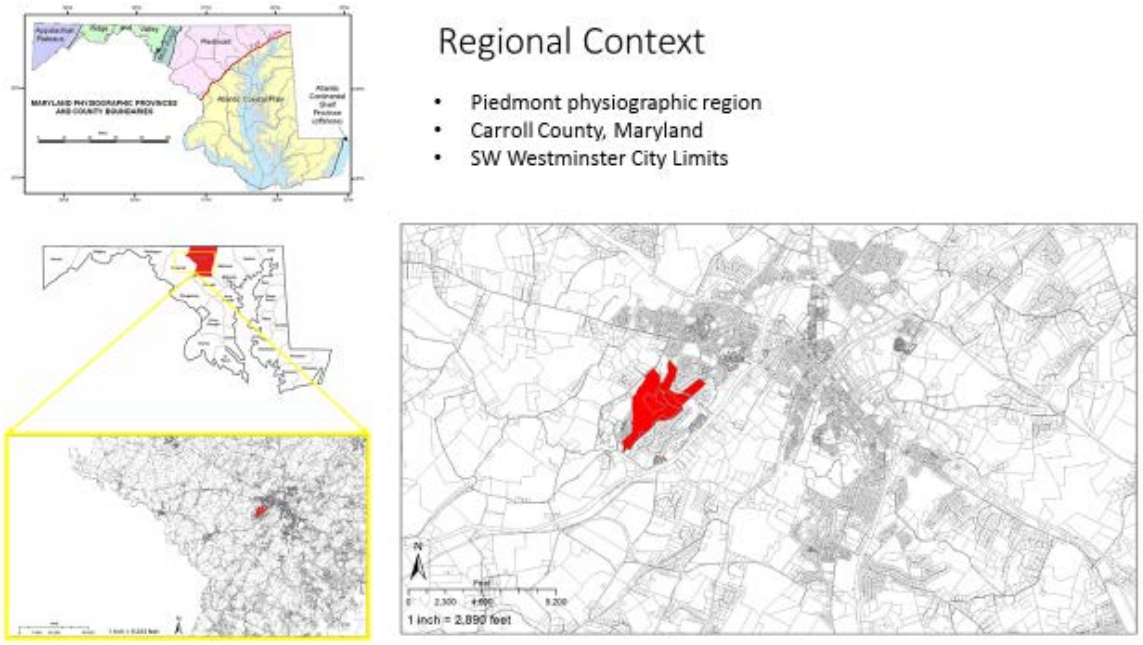
Figure 4.3: Wakefield Valley Golf Course

Figure 4.4: Views of Wakefield Valley after Closure

Chapter 5: Site Inventory and Analysis

Wakefield Valley Golf Course was closed in the summer of 2013 due to financial troubles. It is in central Carroll County, on the western limits of Westminster, in the piedmont physiographic region (fig 5.1). Since having the land donated to them by a developer for compensatory water rights, the City of Westminster has announced general plans to use the majority of the site as a community park, but no detailed plans have been made available. As the largest remaining 'open, green space' in the Westminster city limits, it is prudent to consider how this site should be repurposed

Figure 5.1: Wakefield Valley Regional Context



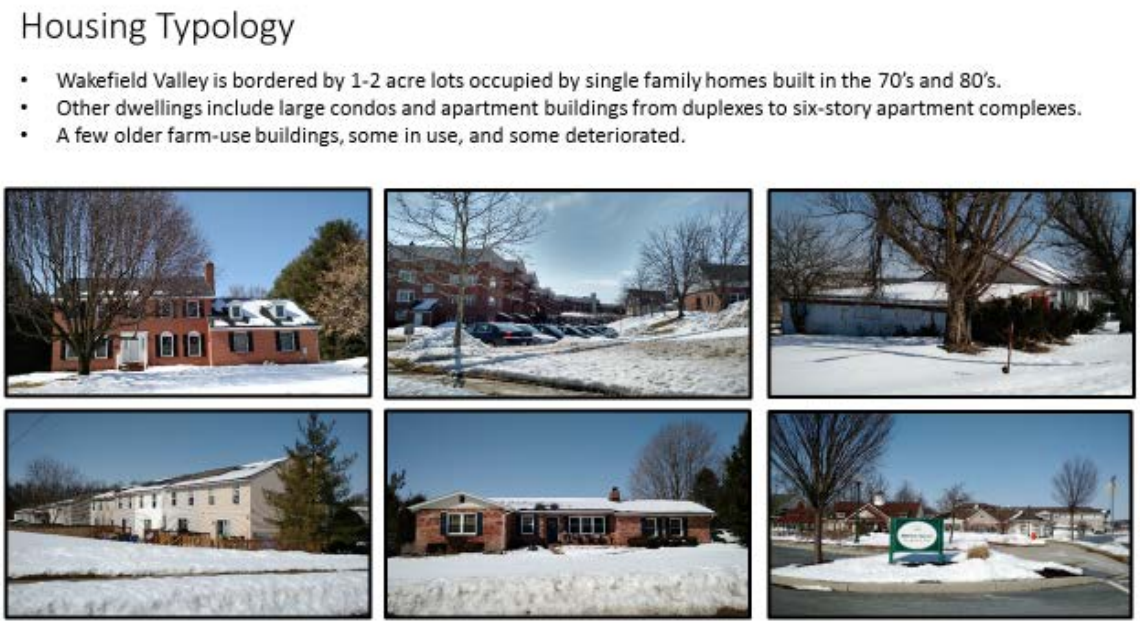
Construction of Wakefield Valley Golf Course started in 1978, and has acted typically to preserve a large patch of green space, while the land around the site has been developed. The delineation of part of Wakefield Valley as flood plain area had some impact on the conservation of this space. The entire site is zoned for conservation, as shown by the Westminster Zoning map (fig 5.2). Much of the city is established as planned in this map. This map does well to show how significant a green space Wakefield Valley represents to the city, much larger than any other parcel inside the city limits.

Figure 5.2: Westminster, MD Zoning Map

Regarding the city demographics, there are approximately 17,000 residents in Westminster, 86% of which are white. Recently, between the census years 2000-2010 there was a 100% increase in the percentage of Latino's in the county from 6%-13%. 25% of the population is high school age or under, and over 3,000 more are enrolled at the two nearby colleges. These numbers are typical of the rest of the county, as well. There are a number of potential users for this site including community residents, recreational groups, businesses, schools, health facilities and more. Three cultural tours or trails border the site; Wakefield Valley Community Trail, Carroll County Barn Quilt Trail, and the North Westminster Bicycle Tour. Programs and organization like the Westminster Arts and Culture task force and the UMD Extension CC 4H are active in the area and could participate in site programming.

The Western and Southern edges of the site are bordered by farm lands and rural one-and-two-acre lots of single family housing mostly built in the 70-90's. Many of the older homes are small one-story brick or paneled ranchers (fig. 5.3). There are also larger, newer, homes on the North and East sides of the course; the two sides that are on the 'city side' of the site, closer to downtown Westminster. This land-use scenario, in part, is similar to the common context of golf courses discussed earlier. Much of the site is bordered by real estate development while much of the 'undeveloped' space around the site is agriculture, as opposed to a more diverse wildlife habitat space.

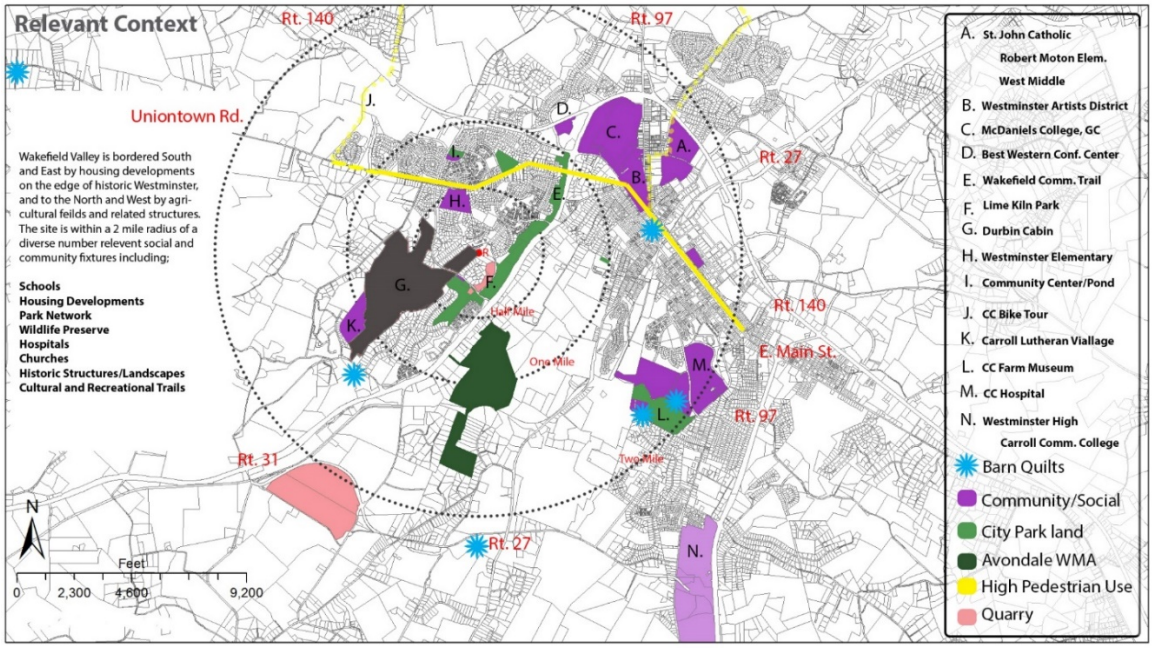
Figure 5.3: Housing Typology around Wakefield Valley



Views from the surrounding houses into the Wakefield Valley range from long and open, to being screened entirely by evergreens, but most of the newer houses take great advantage of these views. There is an old pine forest on the SE side of the site that screens the views of the houses there, but on the Eastern edge of the course the lawns run right up to edge of the golf holes. Recognizing and engaging these edges is an import part of designing for these sights. There are also two corridors, or legs, on the North side of the course surrounded on three sides by houses.

Needless to say, serving the needs of this rural population on a site bordering the densest population area in the county provides a unique opportunity. The majority of Main Street in Historic Downtown Westminster is within a 2 mile radius of the NE corner of the site (fig. 5.4). The downtown area accommodates relatively high pedestrian activity. There are traditional small storefronts and restaurants pushed up against the Main St. sidewalks. There are several small parks and historic structures. In the last decade the community has made a concerted effort to extend this pedestrian core out into the suburban development to the West toward Wakefield Valley; not commercially per se', but recreationally and educationally. This makes the investment in trails and parks in the direction of Wakefield Valley important for the future and history of the community.

Figure 5.4: Relevant Context



There is a growing park system, the Wakefield Valley Community Trail that currently terminates near the border of Wakefield Valley. The trail consists of 70 acres of linear park stretching from McDaniel College, a little over a mile away. Much of the land used to create this new park system was recently donated by the communities and developments that surround the stream valley of Copps Branch. The headwater of Copps Branch emerges from a stream near McDaniel College and runs parallel to Hwy 31 toward Wakefield Valley. The stream runs through the entire site then into Little Pipe Creek. The park and trail system is biker friendly in many sections, though not all. This is something that should be addressed in the design, as well as connecting the trail to the cultural amenities situated at the opposite end of the trail.

Another important piece of context for the design is the Carroll Lutheran Village bordering the Southwest corner of the site. This is a 90-acre Continuing Care Community opened in 1979, around the same time as the golf course but unaffiliated, and expanded through 2007. The campus includes about 300 apartment homes, 100 single family homes, 50 assisted living suites, and 100 skilled nursing beds. There are approximately 500 additional patients who seek outpatient therapy annually and as many full-time employees. There are several community garden spaces and a small trail network. The proximity of this site is an important potential connection when considering who this design can serve in the community. The therapeutic potential, considering the immediate connection to such a large public space, is immense. A therapeutic leg of the landscape could potentially Connect to the Carroll Lutheran Village, and run out into the former Wakefield Valley golf course, great expanding therapeutic opportunities.

Carroll Elementary School is approximately 300 yards away from the Northwest leg of the site. There is no immediate connection, without crossing one of the residential streets. This needs to be addressed in the design through enhanced crosswalk, traffic signal, or pedestrian bridge or tunnel. The most likely solution being an enhanced crosswalk, improved signage and perhaps a flashing crossing signal. The few hundred yards between the school and the site are occupied by a small community playground and a stormwater pond, both which could be tied into the continuity of the design.

Other relevant sites within a two mile radius include high schools and middle schools, a large hospital and medical campus, the Westminster Farm Museum and Carroll Community College; all of which are located on the Western portion of the two mile radius circle. The farm museum is traditionally operated. The farm buildings were restored, and the site is maintained as a working farm to provide an historical experience. The goal is to replicate, recreate, and display local heritage as it pertains to the regions first farms. The space is used for large outdoor events like the Maryland wine festival, but for most of the year it is open by appointment only.

There is also a Best Western hotel and Conference Center, built in 1984, North of the site near McDaniel College. This is relevant because in such a small town it's necessary to consider the relationship of this conference center to the Wakefield Valley conference center building. The two conference centers were built within a few years of each other and one may have had an impact on the success of the other. Wakefield valley has a more scenic setting, being part of the 244 acres that is the Wakefield Valley Golf course, but the Best Western Conference center is closer to downtown Westminster and right next to McDaniel College, as well as being closer to the airport (3 miles), all which are important factors in the function and use of the two spaces.

North of Uniontown road, about a mile from the site there is also a small community center and pond. It is a one story building next to a half-acre stormwater pond. There is playground equipment behind the building as well as some recreational and leisure spaces for horseshoes and volleyball. This building is used for small community meetings. Possible community uses for the Wakefield Valley Center should take this building into account, not in terms of competition, rather as supplemental to it as a venue to host community events. The new space could provide outlets for events and meetings that are too large for the current community center, and could allow growth and diversity. There are a few maintained ball fields near this site as well, in addition to another field just east of Wakefield, so unless there is an unusually high demand for fields in this area, it may not be necessary to have structured ball fields as part of the design. Based on size alone, the recreational potential of the Wakefield site is much more extensive.

Another relevant tract of land is the nearby Avondale Wildlife Management Area, about a half a mile east of the site. It's a primarily forested zone managed by the DNR for

hunting, environmental contributions, and seasonal trail use. There are 27 acres of grasslands on the northern portion of the site, but it is mainly a deciduous forest. There are no streams running through the site or large ponds, and deer are the primary animal managed there by the DNR. Though wildlife and recreation are both a piece of the programming on this nearby site, the interactions and experiences of the sites are completely different. While hunting is the primary form of recreation at Avondale, it will not be part of the design of Wakefield Wildlife reservation. Rather, the appreciation of, and protection of species will be the key intentions of the reservation.

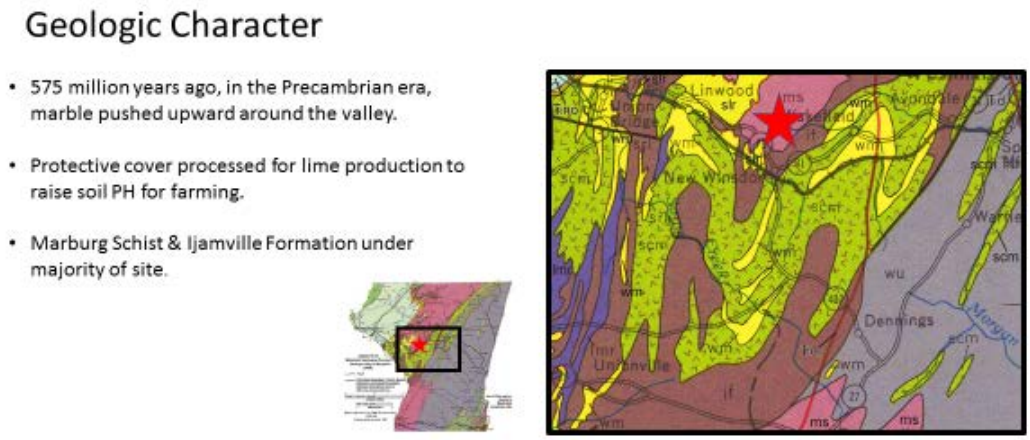
Regarding the aforementioned trails and tours in the area as cultural components, another example of community initiatives, in addition to the Wakefield Valley Community Trail, is the Carroll Country Barn Quilt Trail, established in 2013. This trail is an indication of the influence that agriculture has had on the regional culture. The concept involves regional farms painting historically rich designs on 8'x8' square panels, which are then displayed on the side barns, usually near the road, to be viewed as part of a county-wide tour (fig. 5.5). There are 22 barn quilts currently in Carroll County, which is one of two counties in Maryland with this type of art trail. Several barns are close to the site, and a new quilt was just added spring 2015 on the "Farm Content" barn bordering the Southern entrance of the site. The history of the Barn Quilt as a cultural symbol rooted in the era of agricultural dominance in the region became the major theme carried through the design.

Figure 5.5: Carroll Country Barn Quilt Trail Information

Actually, the beginning of this relationship between the landscape and agricultural practices can be traced back over 500 million years. In the Precambrian era, several large veins of marble pushed upward forming the ridges that now surround Wakefield Valley.

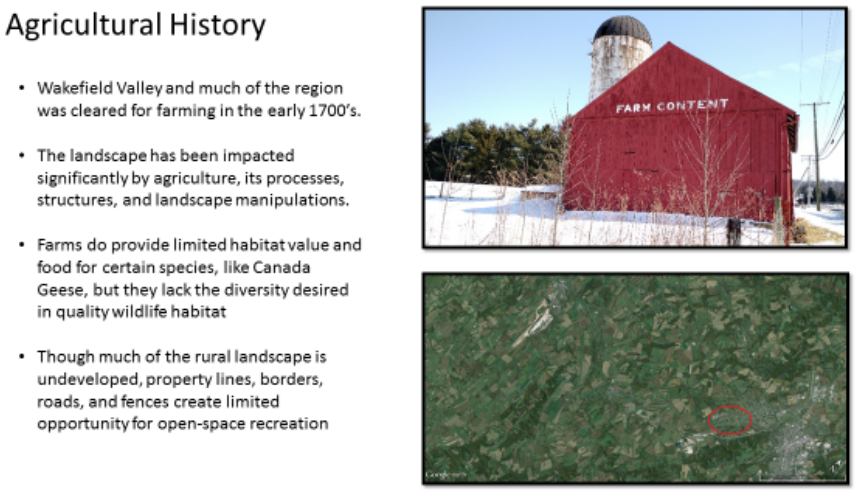
Historically, these ridges were mined for marble as well was the protective mineral covering the marble, known as Phyllite. Phyllite was mined, processed, and converted to lime using large stone kilns. The lime was needed to raise the soil pH for agriculture. One of the kilns used in this process is extant, in ruin form, located between the current endpoint of Wakefield Valley Community Trail and Wakefield Valley Golf Course. It is in such poor condition, eroding and collapsing down the hillside, that the city has roped it off with yellow tape for safety reasons. Specific to the geologic composition of the Valley itself, the majority of the site is composed of fine grained Marburg Schist and Ijamville formation, which is phyllitic slate (fig. 5.6).

Figure 5.6: Wakefield Valley Geologic Map



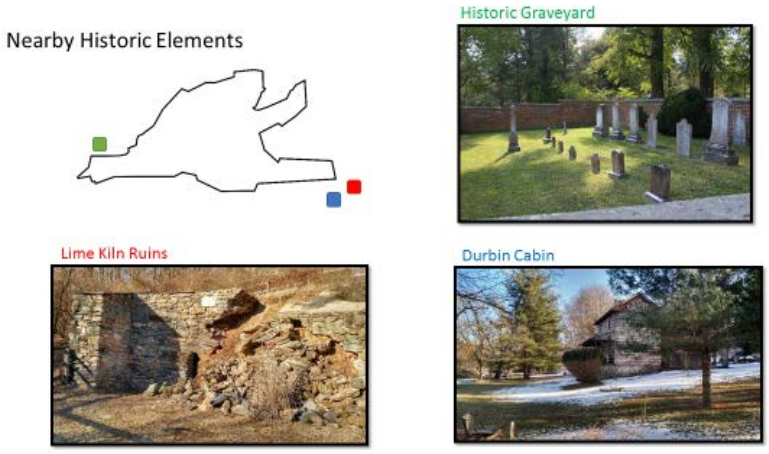
It is also important to point out some of the ubiquitous impacts that agriculture has had on the regional landscape. Croplands, roads, fences, barns and silos dominate the region (fig. 5.7). The overwhelming geometry shown in the aerial image is an indication of that legacy. Wakefield Valley is situated between an area of suburban real estate development and vast acres of farmland that have been operating as such for centuries. Key to the development of this thesis is the recognition of the limitations regarding wildlife habitat diversity and recreational opportunities created by these landscape manifestations. There is a common perception that open spaces, wildlife habitat, and large areas for free-roam recreation are abundant in rural areas such as this. But these basic observations tell a different story.

Figure 5.7: Images of Agricultural Legacy



Several remnants of this legacy are located very near Wakefield Valley. The aforementioned lime kiln, an historic cemetery, a small log cabin, and other iconic farm structures also border the site (fig. 5.8).

Figure 5.8: Historic Elements around Wakefield Valley



On any site, the soil profile has a great influence on the type of vegetation that will thrive there. Before being cleared for agriculture in in the mid-18th century, the vegetation on site was likely a mature Oak/Maple/Hickory forest. The use of the land for agriculture for over two centuries likely had an impact on the soil profile as well, in terms of pH and nutrient loads or availability, as well as irrigation impacts, and potential contamination

from herbicides and pesticides. The management of the landscape as a golf course likely had similar impacts regarding soil profile, as well in terms of aerification and top dressing with sand, the establishments of large swaths of turfgrass, varied irrigation practices, soil compaction, and chemical applications and nutrient loads. The land is composed entirely of Group B or C soils, the former of which is generally well drained. On the below diagram (fig. 5.9) well drained B soils are indicated in shades of green, areas with group C soils indicated in shades of blue which tend to hold more water. All soils are categorized as some variety of silt loam or loam, and the drainage variations are dictated primarily by slope. These landscape conditions help form three distinct topographic zones; Riparian, Transitional Meadows, and Uplands (fig. 5.10). These established zones inform the habitats targeted in the Reservation design.

Figure 5.9: Wakefield Valley Soil Survey

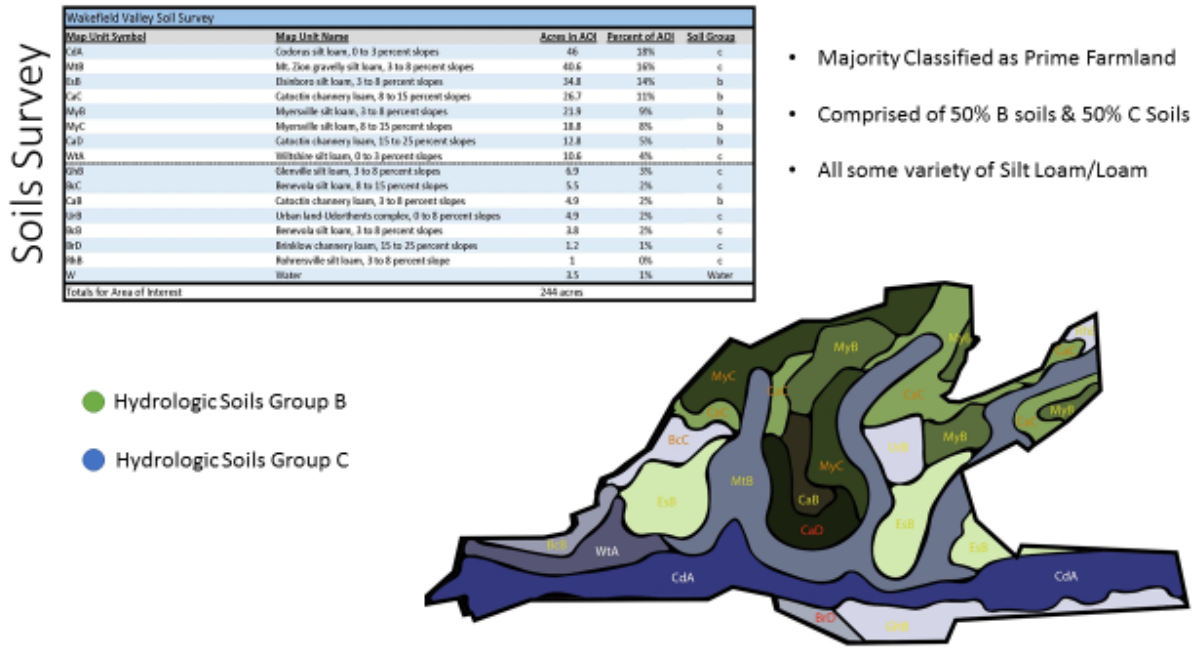
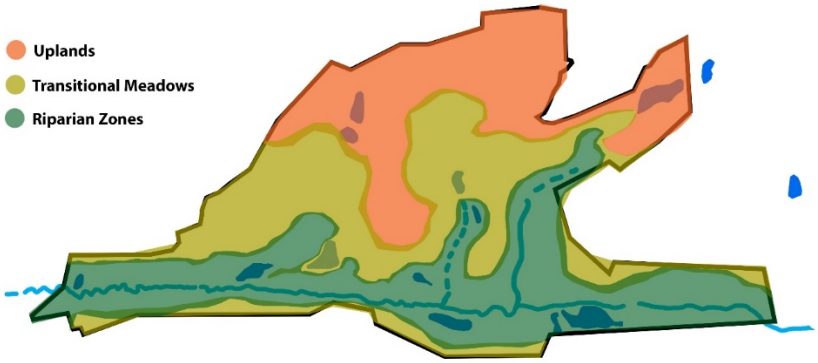
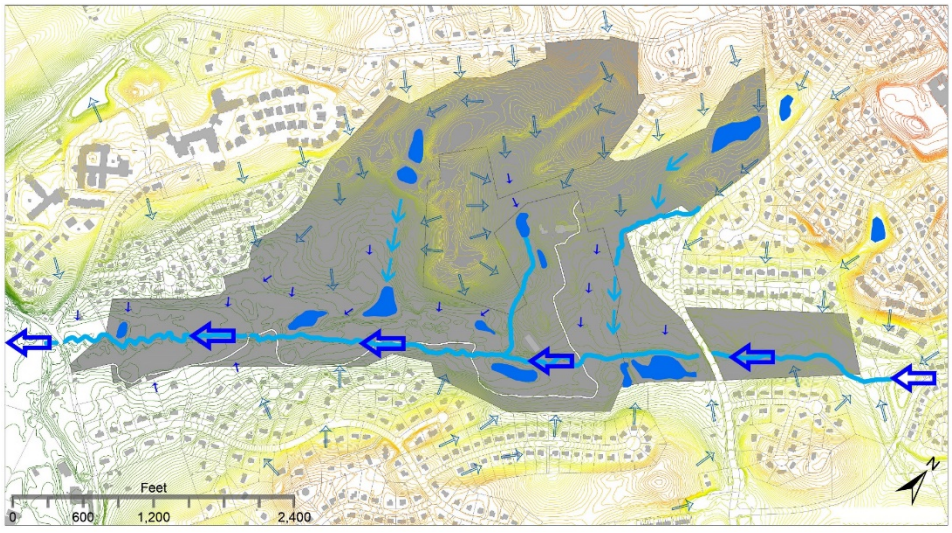


Figure 5.10: Diagram of three ecosystem zones



Topographically the site elevates 146’ from the SE corner to the NW corner; from the 528’ to the 674’ contour line (fig. 5.11). This is an ideal elevation range for a golf course, allowing for open play with challenging and interesting terrain that can affect the roll of the ball and strategy of the game. Most of the land is canted in some fashion toward the Copps Branch stream valley. Ten significant water bodies (pond and wetlands) are currently on the site, in addition to Copps Branch stream and several smaller tributaries. The berms and general landforms around the water bodies suggest that they were built on the site during its development as a farm or golf course as opposed to being natural water bodies.

Figure 5.11: Wakefield Valley Base Map



The extensive hydrologic system, as well as the mature forested patches, and the open fields that use to make up the fairways are all contributors to a diverse ecosystem base, though the overall status of the site as habitat would not be considered high-quality as it currently stands. Copps Branch enters the site as a significant first order stream, and exits 1 ½ miles later a second order stream after being joined by several other first order tributaries along the way. The total catchment area is approximately 1800 acres. Water falling in this catchment flows through Copps Branch, into Little Pipe Creek, to Big Pipe Creek, to the Monocacy River, to the Potomac River, into the Chesapeake Bay, and finally out to the Atlantic Ocean. There are also three small tributary flows from the surrounding high-ground on site toward Copps Branch.

The largest chain of ponds on site is in the Western valley of the reservation where there are four large, bodies of open water. In this section, water moves from pond to pond in 1 foot diameter pipes and eventually outfalls into Copps branch. The first two ponds in the largest pond sequence are some 40 feet higher than the lower two ponds, The upper two of which are separated by a land-bridge that should be taken advantage of in any design as a unique landscape feature. Regarding the lower, larger two ponds, the high-side berm is compromised on the last of these ponds which has allowed water to begin spill out over the edge away from the direction of Copps branch and onto what was a cart path and fairway. This has created several acres of emergent wetland area that eventually ties in with Copps branch further down the valley. The berms on the lower sides of these two ponds are high enough to block the view up the valley if you are on the trail below the berm following along the streambed.

There is a large pond near Tacoma Park Rd in the SE portion of the site designed with several tee and green areas around the edges. These areas are prominently positioned, small scale plateaus that make interesting landscape features. This typical element of golf course design can become something completely different when the context around it changes, which is something that the design explores in this area with the proposed new entrance, and with tees and greens in general, on a broader level. Some other bodies of water are the two small ponds near the clubhouse. They are set in at the Northern base of the main peak, tucked in among some smaller hills and plateaus, and dotted with a few impressive specimen trees that make the scene keenly picturesque.

In addition to the one foot diameter piped sections that move water underneath the golf course between ponds, there are several other common conditions of overland flow spread around the site. Obviously, the character and condition of Copps Branch plays the most prominent role in the overall condition of the areas ecosystem. Though there are some mature trees going across the length of the stream, these vegetative riparian buffers are thin and sparse in many areas. This has been corrected in part by a recent DNR grant through which the city planted several hundred trees since the golf course closed in an attempt to fill out this riparian buffer. The trees are planted in patches in some of the

poorly drained areas following along the stream bed. Aquatic vegetation grows in these areas, and in dense amounts around some of the pond edges in the form of cattails and other hydrophilic herbaceous plants, shrubs, and grasses. The most mature patches of forest commonly have maples, oaks, and elms with various thickness of associated undergrowth. The thickening of these buffers is considered in this design.

Figure 5.12: Existing Forest Cover

Because much of the area surrounding Wakefield Valley is dominated by real estate and agriculture, there is a scarcity of patches and corridors in which to link and take advantage of in the design to facilitate regional wildlife movement (fig. 5.12). Therefore, In addition to joining some of the more significant patches of existing forest on site, the best opportunity to create a patch and corridor network to facilitate the broader movement of wildlife around and through the reservation is in the establishment of a vegetative buffer across the length of Copps branch. This move will connect the two most significant vegetative corridors located at either end of the site, following the Copps Branch streambed into and out of the site, where it eventually joins with an established corridor along the path of Little Pipe Creek. Roads are potential impediments for this movement. There is only one road crossing the site (Tahoma Farm Rd.) and a stream

underpass does well to serve as threshold that allows wildlife facilitates safe wildlife movement, considering the context (fig. 5.13).

On a regional scale this makes sense as well. A healthy corridor network along the streams of the areas will not only provide a path for wildlife movement along water resources that are critical and necessary for their survival, but it can also have influences on the overall hydrologic conditions in the region, the effects of which are felt all the way to the Chesapeake Bay, and the Atlantic ocean.

Figure 5.13: Stream Underpass, Wildlife Movement

Over the last few years it is apparent that many of the trees that do exist in the riparian zone have suffered damage through wind and ice impacts. Many have broken, dangling limbs and others have fallen over completely. While the dangers of this type of habitat have to be considered in any design that will introduce people into the environment, it should also be noted that this type of unmanaged ecosystem, while not aesthetically pleasing to some, can contribute value in terms of wildlife habitat. Therefore, a compromise needs to be considered in the design that allows both aspects of this program to thrive.

The depth below grade of the Copps stream bed varies from about 1 foot at its most shallow to 4 feet at its deepest. The majority of the stream lies 1 or 2 feet below grade, with varying degrees of erosion. There are the typical oxbows and meanders that you see

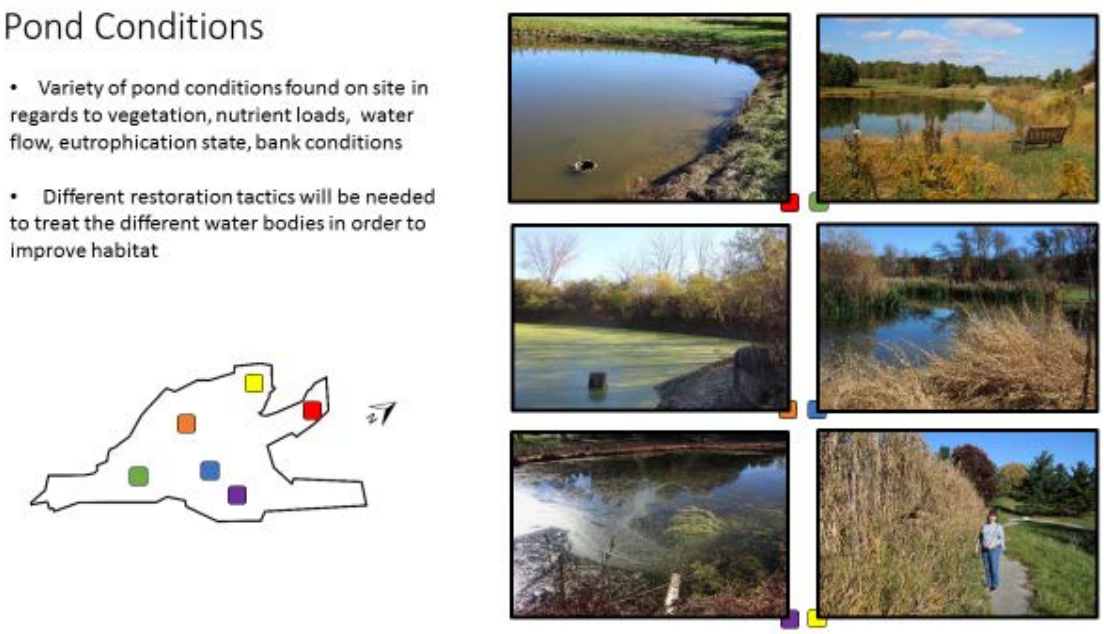
in old fields and agricultural sites of the region but general flow of the stream is from NE to SW and does well to maintain that path as it winds down the valley (fig. 5.14). The streambank does allows overflow in some areas, indicated by tamped down vegetation. The water is generally clear, indicating low turbidity, even soon after rain events. There are also mechanisms used to fill two lower ponds that are not naturally fed by tributaries.

There are some especially attractive oxbows in a sequence near the southern end of the site that should be considered for recreational use simply for its landscape appeal and the context of the scene around it; the pond, a specimen oak tree and the nearby historic graveyard also contribute to the value of this area for passive recreation.

Figure 5.14: Existing Stream Conditions

It is likely from the history of the site that there have probably been issues with nutrient overload, specifically with nitrogen and phosphorus. Golf Courses and Agriculture both have pasts of over fertilizing, and polluting downstream water bodies. The many ponds and wetlands on the site also help to slow and infiltrate water. Consequently there is an interesting mix of pond conditions in the many ponds located on the reservation in regards to vegetation, eutrophication, and perceived nutrient loads (fig. 5.15). Some of the ponds on the upland areas have little or no vegetation, which indicate a poorly functioning riparian habitat symptomatic of pollution or hyper-eutrophication, both of which I believe to be issues in a few of these water bodies. In contrast, many of the ponds further down in the catchment area show signs of healthy vegetative growth.

Figure 5.15: Existing Pond and Wetland Conditions



Based on the existing conditions of Wakefield Valley there are 7 specialized habitat types listed in the Maryland Statewide Action Plan that are existing or to be built upon in the design; Piedmont Streams, Grasslands, Mesic Deciduous Forest, Vernal Pools, Early Successional Forests, Bog and Fen Wetland Complexes, & Non-tidal emergent wetlands. The habitat types fall within three larger categories of habitat that are currently found on site and are the backbone of the design; Woodland, Riverine/Riparian, & Grassland.

Vegetation on the site consists of many small patches and several long lines of deciduous and evergreen plantings, in addition to two larger areas of established woodlands, one deciduous (oak, maple, elm, hickory) and the other white pine. The deciduous woodland patch around a portion of the central peak is the largest contiguous forest area. The pine forest in the southern portion of the site is the second. The pine woodland presents a unique setting by creating semi-enclosed, dark spaces whose floor allows easy pedestrian movement between the many trees. They also create a frame through which to view the open, bright spaces around them. The pine forest itself is made up of two larger patches of forest with various other little patches, pockets, clearings, and corridors.

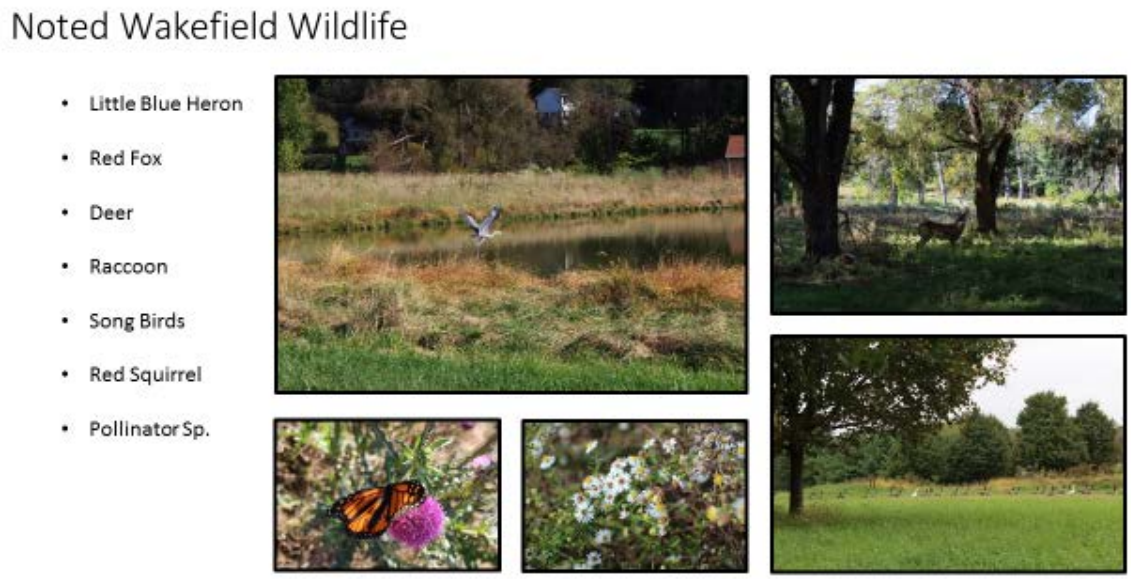
Perhaps some of the best elements of the site are the corridors of mature pine trees that branch off of the larger pine forest and run dominantly North and South, nearly all the

way across the site. These lines of pine trees are not planted in perfect symmetrical rows, rather just 20 or 30 foot wide buffers that were planted in between what use to be fairways. This is a common characteristic that was mentioned in the pieces of golf diagram, and should be taken advantage of in a repurposing project. Using some of these tree lines as overhead cover for asphalt or gravel trail systems is therefore part of the design.

Regarding the existing herbaceous vegetation, it was interesting to see in comparison to the two case studies reviewed in this project because many of the same plants were establishing themselves in the former fairways, rough areas, and patch and corridors of Wakefield Valley (fig. 5.16) Some of these plants are native, others are invasive, but it was interesting to see the golf course starting to succumb to succession. While plans are made for what to do with this landscape, plants and animals are already starting to claim this space as their own (fig. 5.17). These observation show some of the existing value of the reservation as wildlife habitat.

Figure 5.16: Existing Herbaceous Vegetation

Figure 5.17: Images of Wakefield Valley Wildlife



There are also many microclimates within the broader ecosystems that vary because of differences in elevation, drainage, soil profile, and sun exposure (fig. 5.18). Plants that are growing in these spaces now provide clues for what plants can thrive there. For example, greens call for plants that require good drainage, little nutrients, and part to full sun, unless a canopy is established. Bunkers require plants that can tolerate temporary or permanent inundation and can grow in layered soil. Taking these variances into account, these are interesting spaces that provide educational opportunities for succession.

As you would find on many remnant golf courses, there is also an extensive cart path network on Wakefield Valley, though it is falling into disrepair as time passes. The six foot wide asphalt strip that winds circuitously around to the different plateaus that were the tees and greens of the courses has started to crumble and fall apart in much of the lower portion of the site. Large segments of good asphalt still remain in some sections, but the determination of what to do with this material, and how to approach the routing as a component to the trail system will depend partially on time, condition, and funding.

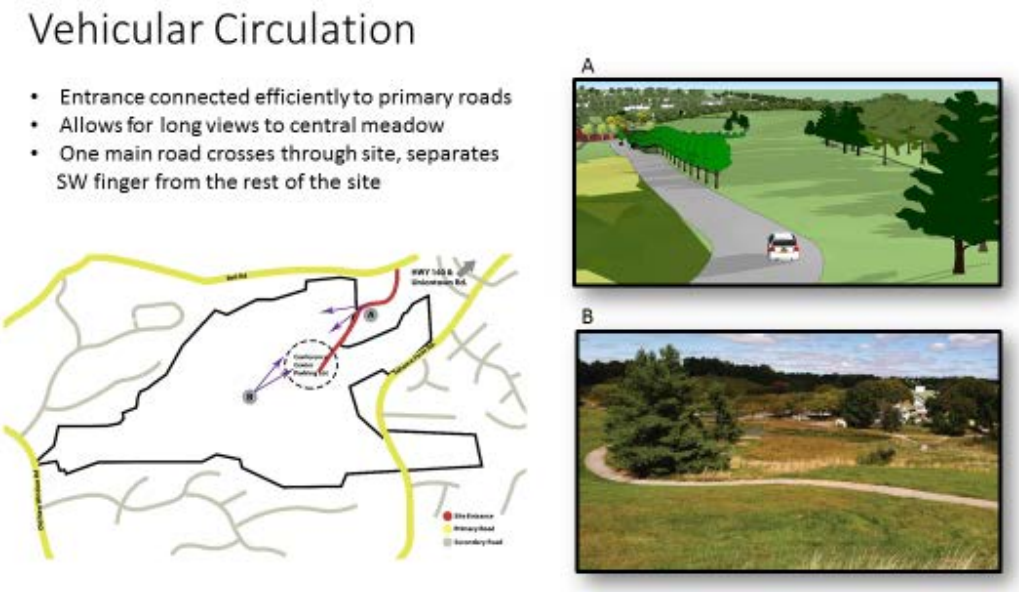
Figure 5.18: Existing Microclimates

There are several great views on the site, not least of which are the views from the prominent peak that juts out into middle of the valley. There is a large forest patch around the sloped areas of the ridge which precludes views in some directions from the very end of the promontory. The high-ground and open grassland around much of the ridge still provides views up and across the valley for several miles. This will be addressed in the design in order to best take advantage of this area of the site for recreational activities like birding, photography, and astronomy. The vehicular entrance to the site allows for similar views, and this road will be maintained as the primary entrance to the reservation because it ties into the largest bordering roads, avoids small residential streets, and remains on the edge of the reservation which is key in establishing contiguous wildlife habitat (figs. 5.19, 5.20).

In addition to existing and potential views that this central point has to offer, there are many views up and down the broad open corridors that were formerly fairway and rough. For the residents of the surrounding communities these views and expanses are just as important inwardly oriented as outwardly. The newer houses especially have an expectation of the view from some of the most well positioned parcels of real estate. And in consideration of the possibility that the Western and Southern portions of the site trend the way of the other sides and give way to newer real estate development, this aspect will be key to the value of those homes as well. The overall design point here is that an effort needs to be made to preserve or enhance the views into the reservation as well as the consideration of the views from within it. These long, framed views are an important elements of the design as it relates to the influence of the picturesque aesthetic.

Figure 5.19: Vantage Points for Good Views

Figure 5.20: Vehicular Circulation Diagram, Images



Chapter 6: Design Framework and Design Development

Design Framework

Through research and specific site examinations, a framework was crafted to help define the intent, function and character of the design. This outline synthesizes preliminary theories, concepts, and inspirations into the design solution.

- Two Overarching Goals:

    1) Provide diverse, high value habitat for key area wildlife species through ecological uplift.

    2) Provide various recreational opportunities for surrounding communities.

- Wakefield Wildlife Reservation Program

    1. Primarily a Landscape for Wildlife habitat and Recreation; highlight succession by providing experience of diverse habitats through trails, viewing areas, focal gardens, outdoor rooms, and promontory look-out tower.
    2. Programmed for walking, cycling, birding, environmental education, photography, astronomy, exploration and outdoor play, as well as various other opportunities for passive recreation.
    3. Connections to Wakefield Valley Trail, Carroll bike trail, and Barn Quilt trail.
    4. Connection to Carroll Lutheran Village therapeutic trail.
    5. Outbuilding and grounds used for research, CC UMD Extension, local schools, colleges.
    6. Conference center as community space, restore restaurant as small café, and accommodate events like crafts fairs, weddings, conferences.

- Golf Course Specific Design Tactics:
    - Utilize green and tee areas to create niche habit and theme gardens
    - Sequential forest establishment in parallel fairways
    - Design primary trail loop utilizing sequencing potential of cart paths
- Ecological Restoration Strategies:
    - Fairway to Native Meadow Conversion
    - Reforestation
    - Pond Fringe Enhancement

Design Development

The pre-settlement character of the landscape as natural habitat, the agricultural history of the reservation, and its existence as a golf course will all be intentionally apparent in the ultimate design. That is, if you visit the reservations decades from now, remnants from the impressions these land uses left on the landscape will be apparent in some fashion. It could be said that restoring the reservation back to the oak/maple/hickory habitat that it was pre-settlement, or even just letting it succeed naturally could be the most beneficial in terms of ecosystem health. But the open nature of the reservation, its context among so much farmland and housing, and the relatively large size provide a unique opportunity for variously scaled and targeted ecosystems for threatened and endangered species. While in the previous two cases we could be adding habitat acreage that may not be in such high demand or potentially allowing the colonization of invasive species, owing to the relatively open landscape of the golf course. Also, since Westminster is a suburban/rural area, habitat may not seem to be a critical need at first glance. But the majority of 'undeveloped' land around the site is agricultural land which is not ideal for habitat (though farms do provide some), and in addition, private. In response to these considerations, providing needed wildlife habitat and public access to a green, open space within walking distance of downtown Westminster are both primary goals of the design that target specific needs of the region.

The potential to develop and integrate the themes of play, therapy, childhood development, and environmental education help provide for spaces that promote cultural and recreation diversity. Design-wise, this idea is anchored in the landscape with edge making an overture to the senior population of Carroll Lutheran, and the opposite edge of the reservation consisting of educational areas and an adventure trail tailoring to neighborhood youth, families, and the elementary school. With this concept, the conference center in the middle, with its 20,000 or more square feet, multiple floors, and spaces, becomes a shared meeting space for these community members and others.

The therapeutic garden and walking trail from the Lutheran Village will lead to the conference center as well, and can be seen as a destination point in its own right. A main feature of the therapeutic garden will be a covered structure near the two upper ponds to the East of the central ridge. The possibility of using some of the special locations on the site as physical therapy goals for those who are rehabbing their mobility is an exciting possibility for the space. The adventure trail loop stretches across several different themes of ecological interaction, including a small day-lighted stream, colorful gardens in a cluster of converted bunkers, and exaggerated contours built from the existing ones in the corner of this area of the site. The topography will be designed as abstraction of the contours of the golf course, like the design of the vernal pool, berm, and wetland trail in the riparian zone section of the site.

Another element of the design are Habitat Gardens scattered strategically around the site. These spaces are reserved for immediate and future development of niche habitats and areas that highlight interaction between humans and wildlife. The hope is that these spaces would be funded over time through donations or endowments from private citizens, civic groups, or community businesses. Most of these gardens spaces are located in areas that were sculpted to be greens, tees, and ponds for the golf course. Each garden would be programmed as a space that promotes interaction or integration with the wildlife. Example gardens could include an aviary, bat-house, butterfly house, fishing docks, the viewing tower, environmental art, and sculptures.

The programing and use of the existing conference center, out-building and Durbin house were also considered in the design. The conference center is designed to accommodate a variety of users and activities. Restoring a small part of the restaurant as a deli or café with outdoor seating will take up a small part of the building. Other parts of the building are used for 4H youth and community meetings. The 4H environmental programs can take advantage of the site for education, camping, and their existing agriculture programs to diversify the programs while keeping some consistency in what the UMD Extension Carroll County 4H program likes to accomplish. This also provides the opportunity for and agricultural education and research programs that uses sheep in some small role to help manage certain grasslands through grazing as well as fill this component of livestock husbandry.

Several preliminary design iterations were created. These exercises began to delineate the large habitat zones, and helped to formulate and test ideas for programing and relationships (figs 6.1, 6.2, 6.3). Some of the most important choices made during this process were identifying the location of the central tower, the use of colorful patches of grassland representing different seed mixes reminiscent of and inspired by the barn quilt patterns, the location of the therapeutic gardens, habitat gardens, the White Pine Meadow Trail, and the general routing of the primary trail. An image of the potential landscape created in fairway to early successional forest/meadow scenarios was also generated (6.4). The continued development, diagraming, and testing of these ideas were the catalysts for the production of the final design for Wakefield Wildlife Reservation.

Figure 6.1: Preliminary Design

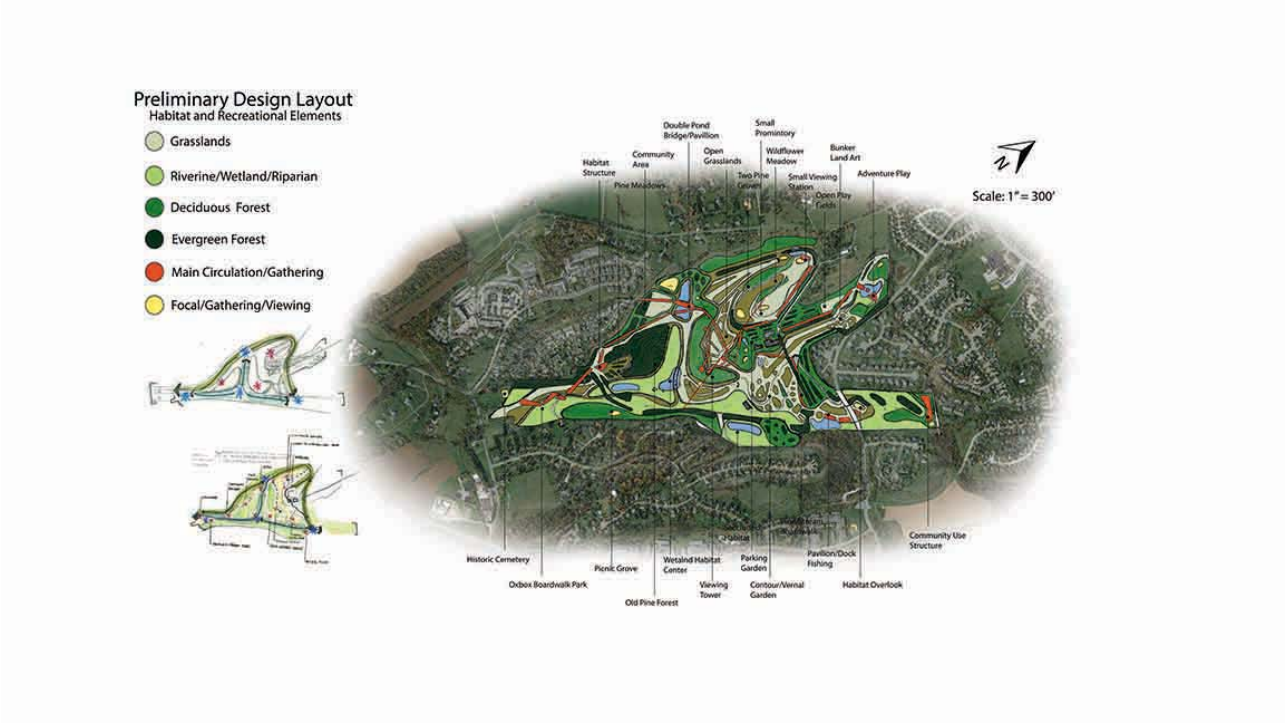


Figure 6.2: Second Preliminary Design Iteration

Figure 6.3: Labeled Preliminary Design

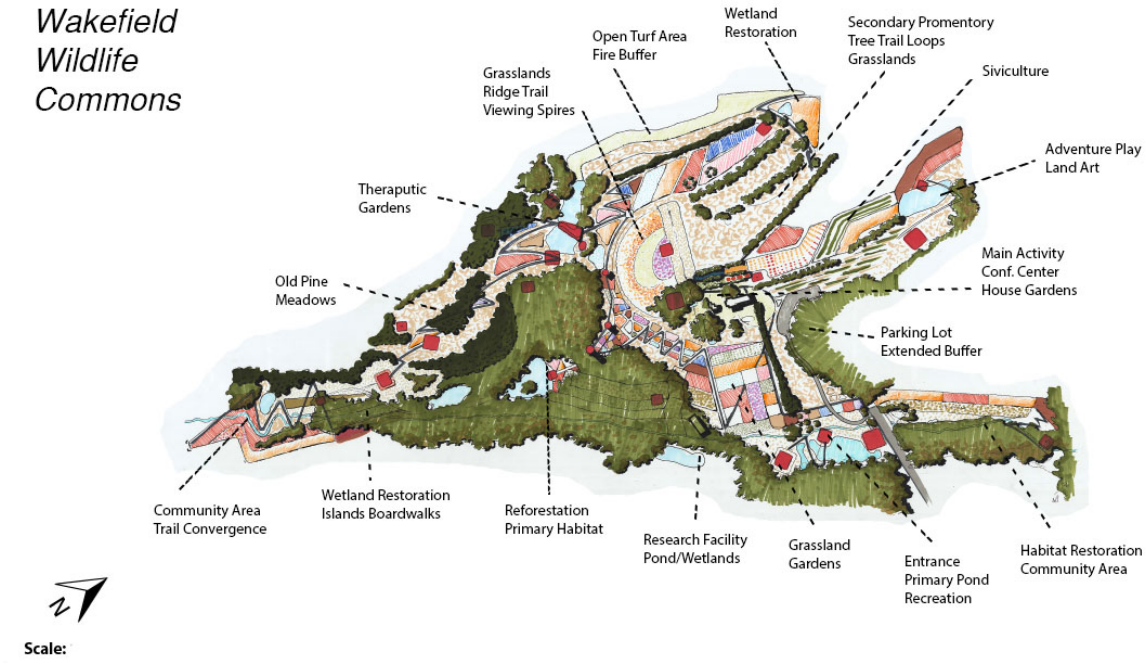


Figure 6.4: Fairway to Early Successional Meadow Image

Chapter 7: Design Solution, *Wakefield Wildlife Reservation*

Wakefield Wildlife Commons is designed as a community park for wildlife habitat and recreation. The broad forces of Wakefield Valley's formation are forests, farms, residential development, and golf; these are the major players in the site's landscape history. Through this lens, the Reservation will be developed as a destination point for the city of Westminster's growing interpretive park and trail system. The intent is to preserve and augment the values of the Reservation and re-think the integration of habitat and recreation in this setting.

The design incorporates three broad ecosystem types using the existing ecology and potential of the site; streams/ponds/wetlands, grassland, and forest. Within those broad categories there are 7 target habitat zones that make up the different ecologies in the design; Deciduous Forest, Early Successional Forest, Grasslands, Emergent Wetlands, Ponds and Wetland Complexes, Vernal Pools, Piedmont Streams, as well as areas for targeted silviculture research and edible forest edges. The below diagram delineates those spaces (fig. 7.1). The target zones were based primarily on soil profile, hydrology, topography, and existing vegetation. A primary goal in the design was to create large, contiguous patches of these habitat zones to aid wildlife movement and provide necessary space for a variety of wildlife species, as shown in the diagram.

Figure 7.1: Target Habitat Zones

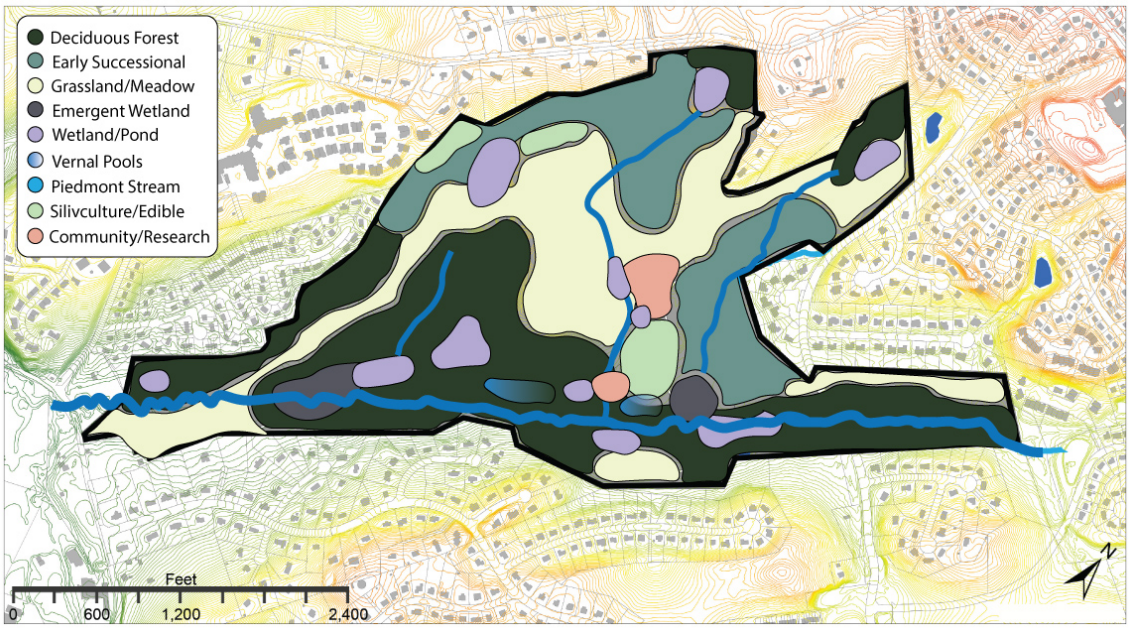
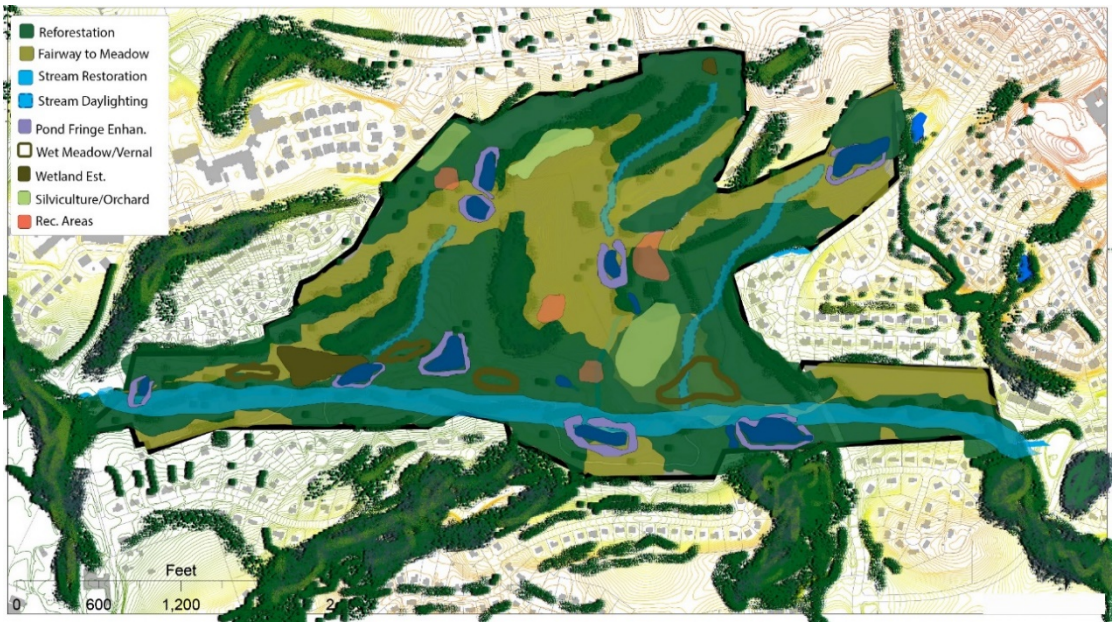


Figure 7.2 shows the necessary ecological interventions that are married to the establishment of these target habitat zones. They represent the actions that must be taken to reach these goals. These actions include reforestation, fairway to native meadow establishment, stream restoration, stream daylighting, pond fringe enhancement, wet meadow and vernal pool establishment.

Figure 7.2: Ecological Restoration Strategies



The below diagrams show intensity of use for recreation and the functional layout (figs. 7.3, 7.4). The three highest activity program elements (indicated by the two darkest shades of red) are clustered in this area for several reasons. The primary reasons being that the vehicular entrance, the parking lot, the conference center, the Durbin house, and the maintenance building are all located in this area. Not only that, but the nature of this project as a repurposing effort challenged me to use the existing buildings and parking area, and figure out how to incorporate them into the design. The choice of clustering these high activity areas (recreation/research) also help delineate large patches for interior habitat, represented by the light pink. The looping red line represents the primary trail system and the routing is pushed toward the edges of the property to reserve larger spaces for habitat, as well. There are also areas on the edges of the reservation designed as spaces for ‘local’ use by nearby residents who can access these spaces directy.

The functional diagram shows the program elements designated for each space. In addition to the large primary habitat zones and ecologies, the lookout tower, research hub, and the community building are also shown. Also indicated are the therapeutic garden trail, the White

Pine Meadow Trail, a wetland boardwalk area, and several spaces for silviculture and edible forest edges. Additionally, the local use areas, as well as several smaller spaces around the site that take advantage of greens and tee areas for habitat or ‘theme gardens’(t.g) are strategically located to take advantage of existing conditions and potential relationships between ecologies, uses, and context. At the top of the central ridge there are also a picnic area and a small camping grove.

Figure 7.3: Intensity of Use Diagram

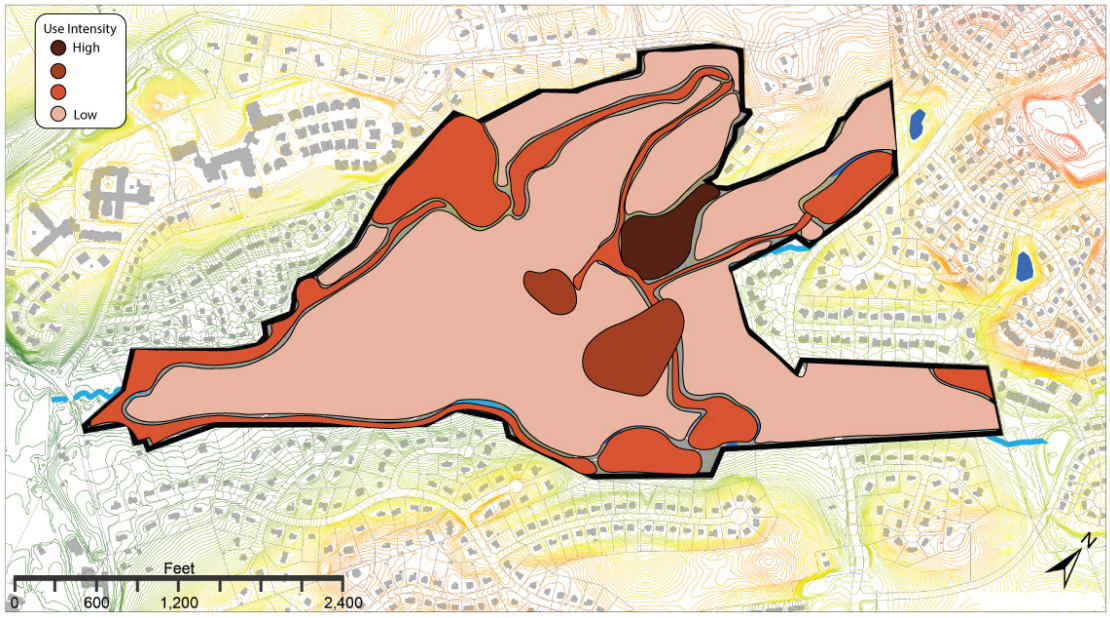
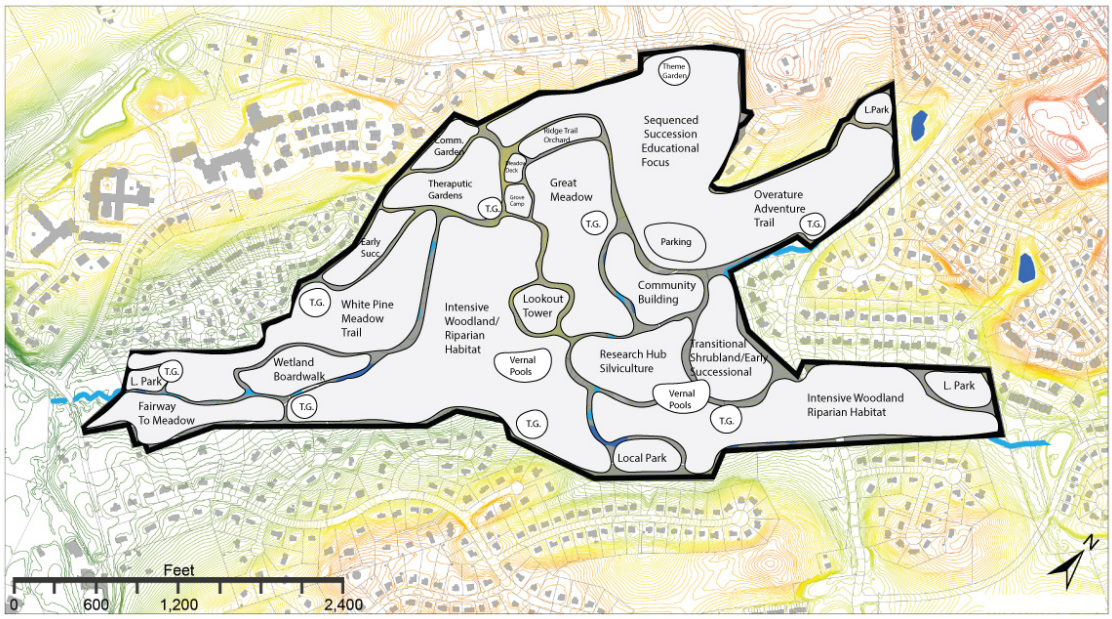


Figure 7.4: Functional Diagram



Design Details

A narration of the sequencing of the Wakefield Wildlife Reservation Masterplan will provide a clear idea of how the reservation is sequenced (fig. 7.5). This idea is best served by following the primary trail system on the reservation. When parking next to the community building there are immediate views into the great meadow, and an ADA accessible trail directly to the promontory lookout tower. From the parking area, the primary trail moves upward in elevation past a large habitat garden and butterfly house at the base of the Great Meadow, before entering the areas designated for sequenced forest succession, and passing by a few small habitat/theme gardens. The trail loops around after working into the corner of the site, where begins the canopied Ridge Trail making use of an existing pine buffer, which works back toward the central ridge providing great views down over the meadow. On the top of the ridge there is an edible forest edge, as well as a space for relaxation, and group activities, and a small camping areas. The trail begins to work downhill to the community and therapeutic gardens that border the senior and assisted living facility. From there, the trail winds through a unique outdoor room called the White Pine Meadow Trail. Now getting down into the lower elevations of the reservation, there is a wetland boardwalk area, and a few more habitat/theme gardens. The trail crosses Copps Branch before reaching the easternmost property line, past a secondary pedestrian entrance and the historic Durbin Cemetery. It goes through a patch of grassland, then along the stream valley on the edge of the intensive forest habitat zone. It continues on, passing near the research hub, where the trail turns and works its way back toward the community building through areas of targeted silviculture and spaces for outdoor events.

The SE pedestrian entrance connects to Tahoma Farm Road, which connects to the existing Wakefield Valley Community Trail, which currently terminates a few hundred yards away. The nearby leg of the Reservation separated by Tahoma Farm Road from the rest of the site, is designated primarily as habitat. The pedestrian entrance trail works its way toward the community building is and is called the ‘Overture Trail’ which is provides a good sampling of all of the habitat zones encountered on the Reservation. And finally the other ‘leg’ of the reservation is home to the Adventure Trail, which takes advantage of some unique land forms, to create interesting habitat/theme gardens, and play-areas that establish a more adventurously themed, small trail loop.

The following section contains more detailed drawings and designs of some of the most critical pieces of the Wakefield Wildlife Reservation Masterplan.

Figure 7.5: Wakefield Wildlife Reservation Master Plan

This long section across the heart of the Reservation does well to show the relationship of the three overarching categories of habitat, stream/riparian, woodlands, and grasslands (fig. 7.6). The great grassland meadow uses the wide open space of the former driving range to establish a 25 acre central meadow patch that represents nearly a 1/3 of the total 80 acres of contiguous grassland on the Reservation. At this size, grassland habitat can support an array of key wildlife species including butterflies like the Baltimore Checkerpoint and large predatory birds like the Common Nighthawk or Golden Eagle, among others. The woodland patch will take advantage of the most established existing patch of forest and the existing white pine forest to create the large patch of interior habitat. The establishment of a wide riparian buffer will create a corridor crossing through the site along Copps Branch facilitating the movement of wildlife, and improving hydrologic function attenuating and slowing the flow of water during storm events. The promontory look-out tower is located on the central ridge of the Reservation, allowing people to look out over all of this from a spectacular vantage point, more than 50 feet above the tree canopy.

Figure 7.6: Overarching Habitat Zones

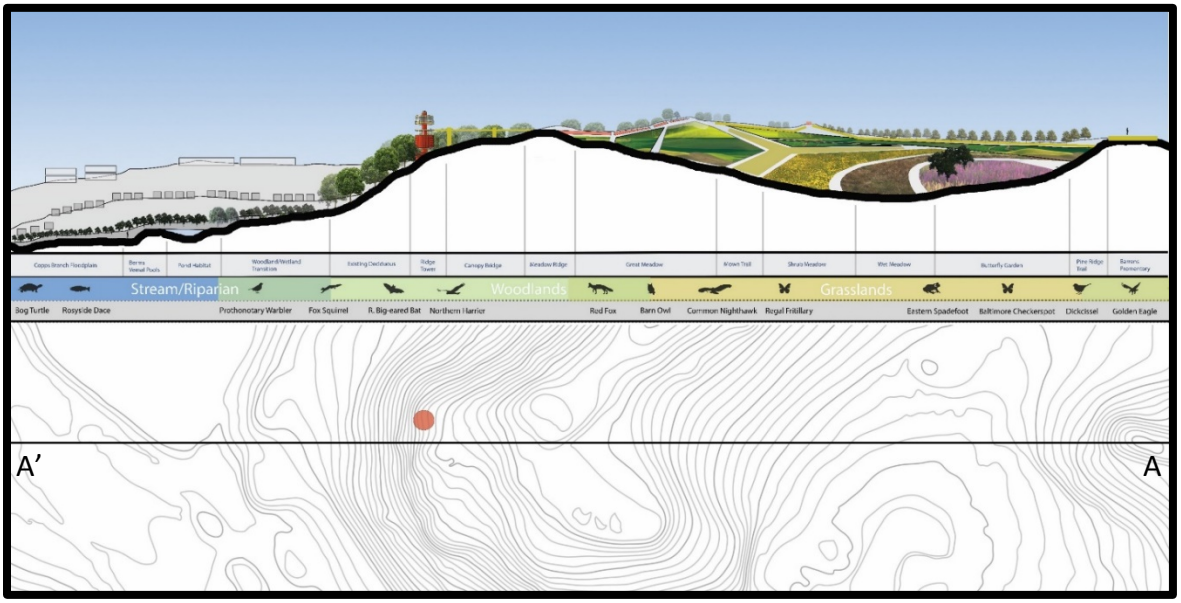
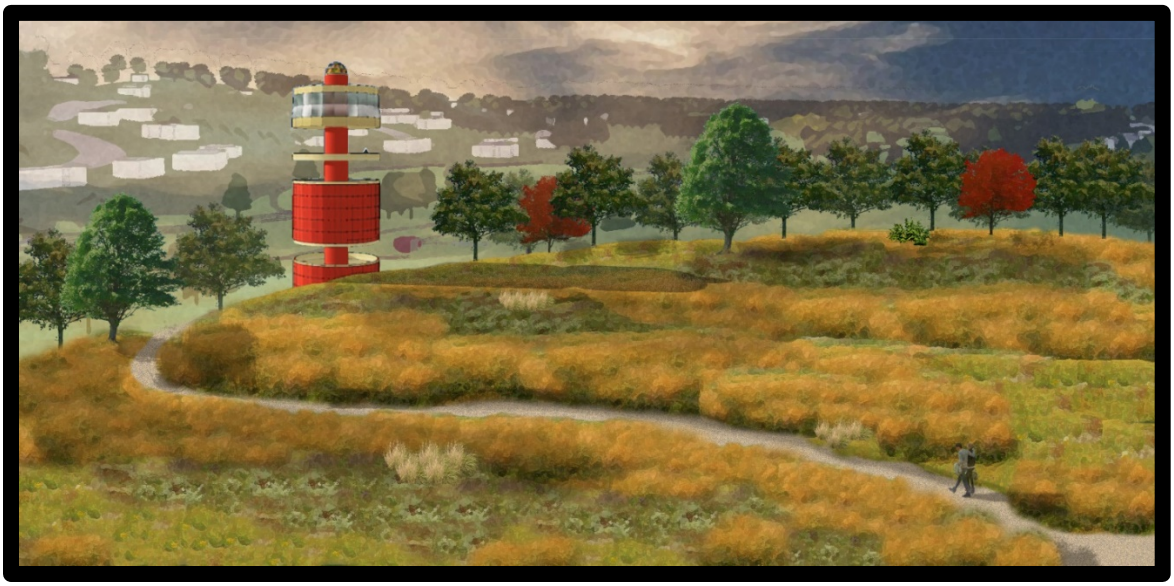


Figure 7.7: Perspective of Great meadow and Promontory Look-out Tower



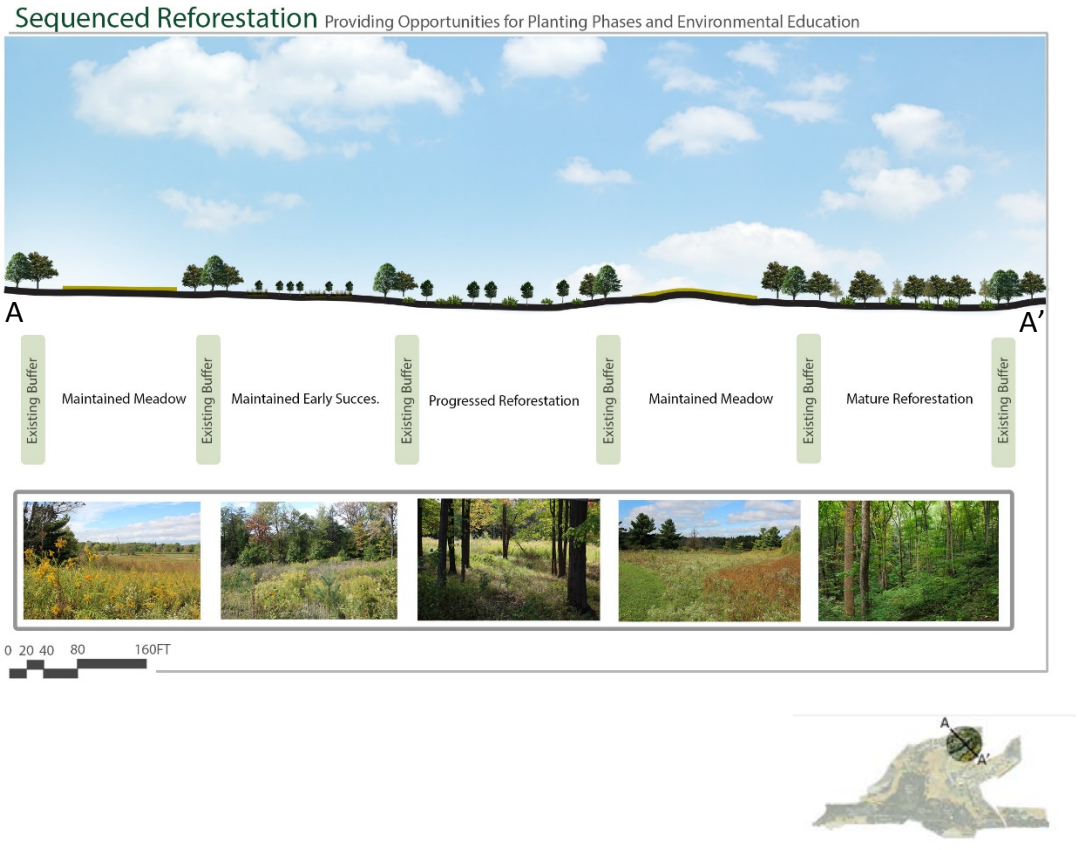
Not only does the tower provide long expansive views over the Reservation and into the landscape that surround it, but it also serves as a focal point to pull the landscape together (fig. 7.7). The design takes inspirational cues from silos of the agricultural landscape; using design details that mimic the quilt-like visual quality of the meadow habitat and echo the barn quilt imagery. In fact a small portion of the tower would even accommodate wildlife, using hollow tiles that allow roosting habitat for certain birds. It is positioned at the edge of the Great Meadow and the intensive forest habitat, helping bring those two spaces together.

The table below is a plant list for areas designated as grassland meadows (table 7.1). Plant selection for this habitat, and all others, was based primarily in wildlife habitat value and existing site conditions. Specifically selection qualities include the number of species that use plants for food, cover, and nesting, as well as plants that provide edible fruits and berries for humans. Extensive plant lists like as this were created for each of the target habitats.

Table 7.1: Plant List for Grasslands, Meadows, Barrens

Scientific Name	Common Name	Target Habitat Zone	Note
Trees			
Pinus rigida	pitch pine	uplands, meadows	full sun, old trees fire resistant
Pinus virginiana	Virginia pine	uplands, meadows	well drained, full sun
Prunus virginiana	choke cherry	Low grasslands	pioneer
Quercus marilandica	blackjack oak	meadows, barrens, greens	acorns, fire resistant
Quercus Stellata	post oak	dry ridges, edges, upland meadows	acorns, existing
Shrubs			
Ilex glabra	inkberry	Site-side (not stream or pond)	evergreen, berries through winter
Rhus aromatica	fragrant sumac	Open upland woods, oak barrens	edible berries, aromatic leaves
Rhus typhina	staghorn sumac	Meadows, forest edges	winter food, good spreader
Rubus allegheniensis	Allegheny blackberry	Meadows, Open woods	edible berries
Vaccinium angustifolium	lowbush blueberry	Dry woodlands, barrens	edible berries
Herbaceous Plants			
Asclepias syriaca	common milkweed	meadows, fields	fragrant flower, existing
Eupatorium hyssopifolium	hyssop-leaved eup.	Meadows, upland, woods	wildlife value
Geranium maculatum	wild geranium	Meadows, upland	adaptable, long bloom time
Oenothera perennis	sundrops	meadows, upland	long bloom time, spreader
Solidago canadensis	Canada goldenrod	Meadows, dry to moist	wildlife value, existing
Grasses/Grass-like Plants			
Andropogon gerardii	big bluestem	meadows, dry to wet	winter interest
Andropogon virginicus	broomsedge	wet meadows, transitions	tolerates drought, good wildlife cover
Carex stricta	tussock sedge	wet meadows, swales	partly persists through winter
Panicum virgatum	switchgrass	meadows, dry to wet	food for sparrow species
Schizachyrium scoparium	little bluestem	Open woods, pine clearings	Excellent forage grass, winter cover

Figure 7.8: Section of Sequenced Reforestation



People will also engage with the landscape through design that highlights change over time. The parallel fairways and vegetative buffers across a section of several holes of the Reservation is a perfect opportunity to design an interesting succession plan that can educate, while establishing the intended ecological uplift (fig 7.8). The chance to see a meadow landscape next to maintained early successional forests of varying ages, next to mature forest, creates an intriguing sequence of spaces.

This graphic below is a perspective looking down one of those fairways for sequenced succession (fig. 7.9). It shows how the greens and tees at the ends of each former golf hole can be designed to provide opportunities to utilize the microclimates to create smaller niche habitats, theme gardens, and overall visual interest.

Another example of how the greens and tees can be used is represented in figure 7.10. This habitat garden is at the base of the great meadow, and is designed a pollinator garden adjacent to a butterfly house. The sculpture in the habitat garden uses textured metals and reflective surfaces, playing with the earlier idea of blurring the line between landscape and culture by reordering visual layers and reflecting the faces of those who choose to investigate it more closely.

Figure 7.9: Perspective of Sequenced Succession, Habitat Gardens

Figure 7.10: Perspective of Large Pollinator Habitat, Butterfly House, Sculpture

Another connection is made with the senior and assisted living facility (fig 7.11). Community and forest gardens will invite people in from the edge, promoting stewardship. A small roofed structure is the focal point in a habitat garden perched above a restored wetland habitat. Installed docks both overlook and take people down to the edges of the upper and lower pond, separated by a small land-bridge.

Figure 7.11: Section of Connection to Carroll Lutheran Village, Therapeutic Garden

Figure 7.12 is view from the other side of the wetland looking back at the entrance of the therapeutic garden trail. It shows the upper and lower pond, and the land-bridge bisecting them. This space is designed with easy path accessibility and use, community gardening areas, and sensory oriented plant selections. The seating area takes advantage of a perched former tee box. The idea is to work with community members to plan, design, and build this area over time as part of the facilities therapeutic programing.

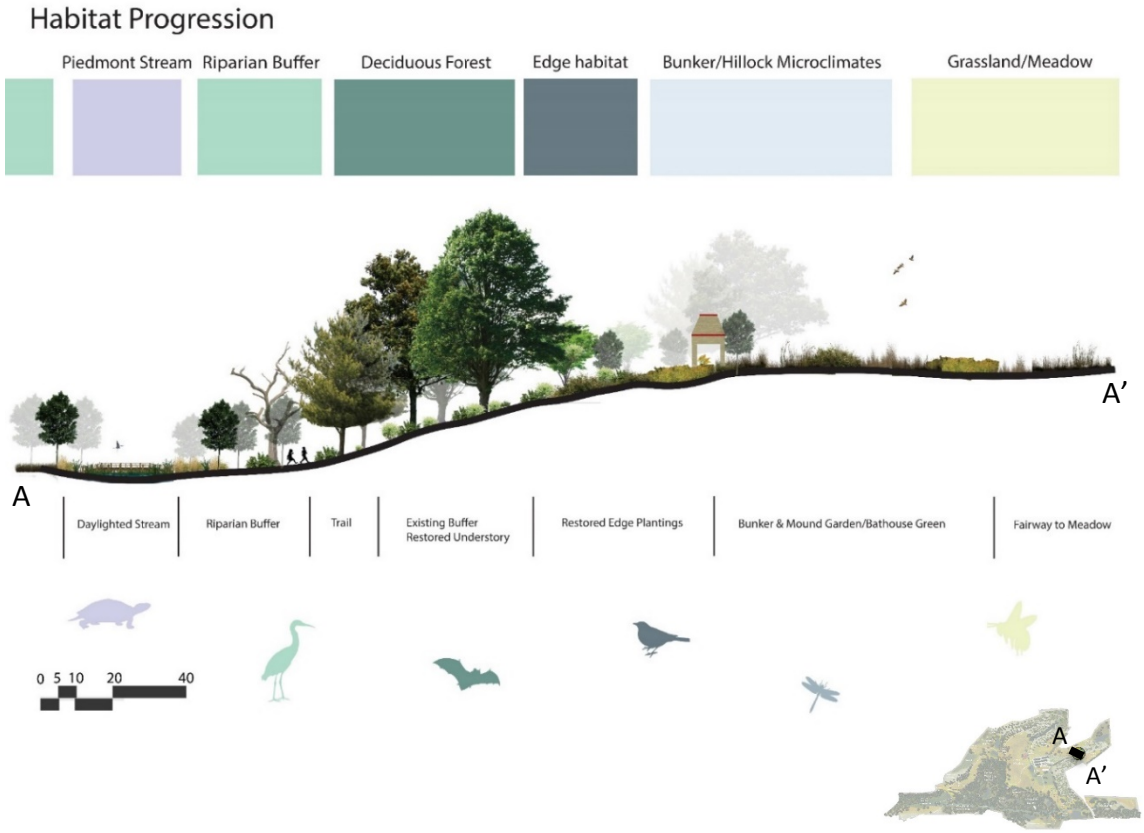
Figure 7.12: View of Therapeutic Garden, ponds, land-bridge

Figure 7.13: View of habitat garden, roosts, vertical flush buffer

Figure 7.13 is an example of a former green succeeding into habitat for birds and pollinators. There are installed roosts for target species of birds to promote feeding. The vegetative edge acts as a soft border to protect the roosts from direct disturbance. Also, the garden is established at the foot of a mature white pine buffer to provide year-long vertical flush spaces for the birds to safely move to when disturbed.

Figure 7.14 shows the relationship of habitat zones on a portion of the Adventure Trail, and some of the wildlife that we can expect to find in these zones. There is a day-lighted stream, with a newly established riparian buffer adjoined to an existing patch of deciduous forest to create a large patch of habitat. The forest transitions to edge habitat and then into grassland. In this case there is also a former bunker and mound system designed as land art and an adventure play area next to an installed bat-house.

Figure 7.14: Adventure Trail section; habitat zones relationships, anticipated wildlife



The perspectives in figure 7.15 show the before and after images of the day-lighted stream. Over a year of site visits, water has flowed continuously through this tributary. The outflow point is currently piped underground toward Copps Branch. The swale functions as the overflow channel during large rain events. This being the case, it can feasibly be converted into a small open stream, establishing a more valuable area for wildlife and recreation.

Figure 7.15: Day-lighted stream, riparian vegetation succession

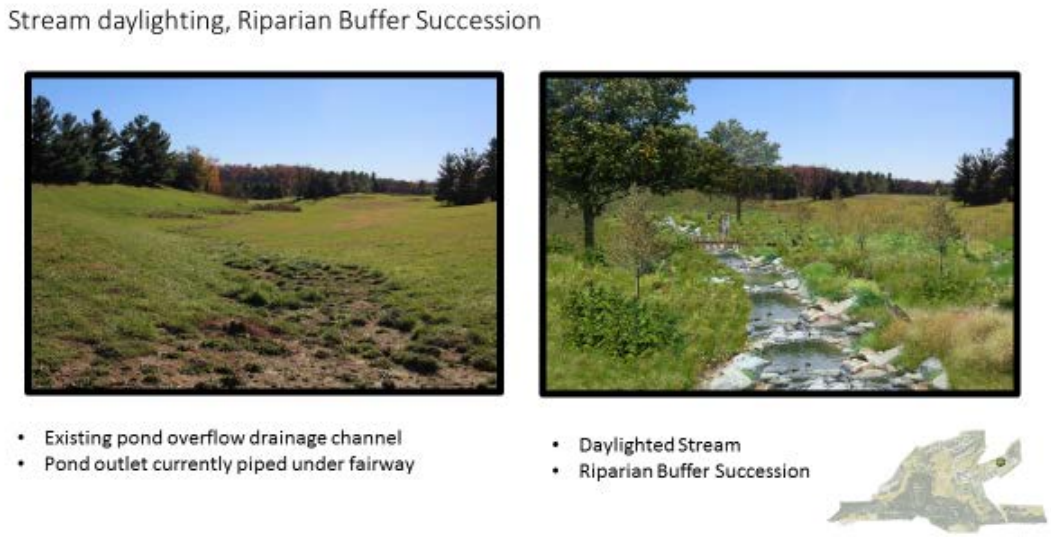


Figure 7.16 is a perspective image of a bat-house as a focal piece for a habitat garden. It also shows the possibility of using stark changes in ground-plane vegetation to indicate a change in habitat. This garden would be near established or emergent wetland areas to promote feeding habits with mosquitos, and among shagbark hickory plantings which are natural bat habitats.

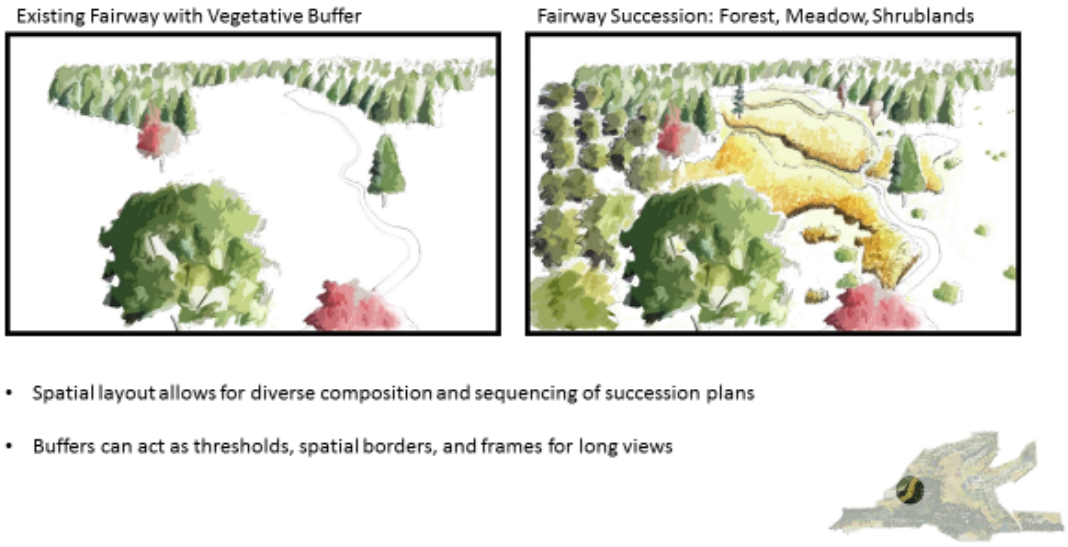
A section taken directly across from the main pedestrian entrance shows reservation near the connection to the Wakefield Valley Community trail (fig 7.17). Again, this leg of the site, is programmed for intensive habitat due to its separation from the rest of the Reservation. A viewing platform will be here as a potential first stop before entering the main area of the site, allowing visitors to look down on the stream and succeeding riparian buffer. Wildlife is currently able to pass under this road, as I showed in an early image, and this movement will be maintained or enhanced.

Figure 7.16: Bat-house Habitat Garden

Figure 7.17: Section by Pedestrian Entrance, Buffer Establishment, Viewing Platform

The below images are of the White Pine Meadow area (fig. 7.18). They show the different spatial layouts and sequencing possibilities using three fairways separated by existing patches of white pine forest. They do well to show how the spatial conditions can change over time. The former fairway on the left becomes the edge the intensive forest habitat zone, native meadow grassland now bisects the two patches of forest creating a unique outdoor room, and the outer edge is maintained as early successional habitat allowing views into and out of the reservation.

Figure 7.18: White Pine Meadow Trail, Spatial Transformations



While this meadow will be maintained as such, there are other fairways that will progress from grassland, eventually into deciduous forest, over years or decades. The following image progression gives a good idea of what those changes can look like over a 20 year period (fig. 7.19). Looking at them side by side you can really see the different visual layers and spatial dimensions created by this guided succession plan. They create educational opportunities on succession, and allow people who frequent the spaces to experience the same space in many different ways over a lifetime.

Figure 7.19: Example of Sequenced Succession

The first rendering, 6 months after the golf course closes, shows untended grass areas of a former fairway. The second image, 1 year after closure, the grasses are going to seed and herbaceous perennials are starting to compete and establish. The next two images, 2 years and 3-4 years after closure respectively, show the growth of herbaceous perennials, annuals, shrubs, and seedlings starting to succeed into the space. The fifth image represents the space 7-10 after closure, as planted seedlings of trees have grown tall and new understory plants begin to emerge. The final image shows 15-20 years after closure, where the meadow has transformed into an early successional forest with associated, shade-loving understory plants.

These types of transformations will be taking place across the Reservation in different ways, over different time periods, and involving different plant communities. The research, design, and implementation of these process all bring exciting challenges and opportunities for education and new discovery, as well as the creation of intriguing spaces for passive recreation and valuable wildlife habitat.

Chapter 8: Conclusions

Owing to the trend of golf course closures, the questions asked and lessons learned from this thesis can have a more significant impact than the transformation of a single golf course. As our ecological sensibilities become more refined and we grow more aware of our own environmental impacts, the need to protect and restore our natural resources is undeniably apparent. The opportunity to repurpose golf courses in such vast numbers allows us to transform spaces that are at times considered to be part of the problem, into landscapes designed as local and regional solutions that appeal to our humanistic goals of a healthier planet; all while serving our communities in more meaningful ways. That being the case, the methodology and framework established through the design of Wakefield Wildlife Reservation can inform future projects in a variety of ways to make a more significant impact.

Many of the reasons these lessons can be transferred to future projects were outlined throughout this paper. They include the inherent composition of golf courses, their common context, and their potential as spaces for wildlife habitat and recreation, and the lessons learned through addressing these areas. In addition, golf holes, and courses at large, are designed by landscape architects who understand and create visual intrigue through the intentional manipulation of elevation change, views, framing, and focal points to craft a challenging and aesthetically pleasing experience for the golfer. When these landscapes are not successful as golf courses, fortunately, they leave behind these design elements, which provide us with a unique, but predictable framework with which the next landscape design iteration can embrace, and expand upon. Understanding these principles and finding new ways to highlight and exploit them was key to the design of Wakefield Wildlife Reservation. These investigations should continue and be expanded upon in similar projects.

Since the game of golf dictates a certain landscape style, these commonalities will be encountered on the majority of golf course repurposing efforts. More specifically, we can expect greens, tees, and fairways to display common relationships with each other in regard to sequencing and adjacencies, as well as individual character and composition. We can also learn lessons in regards to how existing turfgrass affects the succession of different habitat zones and vegetative growth, or similar affects created by layered soil profiles, decades of chemical applications, misapplications, or over-applications, as well as soil compaction. Also, because of their use as irrigation ponds and the possibility of hyper-eutrophication from years of fertilizer treatments, we can expect to find water bodies of varying ecological status. The diagnoses and treatment of these situations is a practice that can be applied across a wide range of design proposals.

Beyond the recognition and treatment of a golf course as somewhat of a modular landscape, there were other methods exercised in the process that are applicable on a

broader level. The inventory, analysis, and cataloguing of existing ecologies and habitats on Wakefield Valley are some of the basic foundations on which the success of ecological design depends. These methods are a critical piece of any design, but especially so when dealing with wildlife habitat design because the quality of habitat is so dependent on the choices made based on these investigations in regard to vegetative succession and intended habitat outcomes. Without understanding the history, character, and potential of a specific landscape, the design cannot be appropriately informed, and therefore has a lessor chance of being successful in the ways that are intended, or missing the opportunity to have a more significant impact.

The true depth of the value of these lessons is in realizing that these concepts and methods can be applied in many more situations, beyond wildlife habitat design and recreation on golf courses. The concepts and theories touched upon in this thesis open up endless opportunities to serve our communities through sustainably oriented design solutions. Designs highlighting storm-water management, urban agriculture, climate change mitigation, and targeted strategies to deal with unforeseen environmental concerns should all consider and expand upon the ideas discussed in this thesis to manifest the intended outcomes. When designing such projects, it is just as important to garner stewardship from the community to make them successful as it is in the case of Wakefield Wildlife Reservation. And the possibilities of environmental education are even more exciting in urban areas. The sheer number and diversity of the typical urban population creates the chance to affect communities on multiple levels and in culturally special ways. Underserved populations can be presented with landscapes that afford the same experiences of nature to which they currently have limited exposure. Other common urban conditions are that the impacts of pollution and the exponential trickle-down effect of impervious surface cover require mitigating landscapes to be designed in response. In each of these circumstances, understanding and utilizing the concepts outlined in this thesis will contribute to the creation of ecologically sound landscapes that also provide memorable experience for the people who use them.

Citing the work of Landscape Architects operating outside the confines of golf courses enlightens us to the breadth of influence golf course repurposing efforts can have. For example, Kongjian Yu (282) identifies four categories of ecological services; 1) Provisioning, related to production of food, water, and energy, 2) Regulating, related to the control of climate and disease and the mediation of flood and drought, 3) Supporting, related to nutrient dispersal and cycling seed dispersal, and habitat for wild plant and animal species, and 4) Cultural, related to intellectual and spiritual inspiration, recreational experiences, ecotourism, and scientific discovery. The size, location, character, and context of the golf landscape give it dynamic potential to serve each these needs in some capacity relative to the needs of specific sites and communities.

In addition to all of the potential applications of research and methods that can inform future projects, there are undoubtedly many other connections that I have not yet made. The unknown possibilities and the discovery of new ways in which similar methods can contribute to the overall body of knowledge in the landscape architecture profession, and beyond, make research in this area an exciting line of investigation.

The confirmation that many golf courses are situated in urban areas and on the edge of large, high-value habitat, further exhibits the potentially broad reach of this this research. There are currently 34,011 golf courses around the world. If just 20% of those courses close in consideration of the fluctuating interest in the game, that represents around 1 million acres of land, nearly half of which is in the United States. As we deal with increasing populations and search out areas within our urban fabrics to focus sustainable planning efforts as catalysts for a better quality of life, defunct golf course represent some of the largest, potentially valuable spaces we have in which to design our futures and the landscapes that will help us get to where we want to be.

Bibliography

Adams, Robert L. A. and John F. Rooney, Jr. *Evolution of Golf Facilities in America*. American Geographical Society. Geographical Review, Vol. 75, No. 4, 1985. 419-438. JSTOR. Web. 7 April 2014.

Alagona, Peter S. *What is Habitat?* Oxford University Press. Environmental History 16 (July 2011): 433-438. Web. 25 November, 2014.

Browning, Robert. *A History of Golf, the Royal and Ancient Game*. [First edition]. Dutton, 1955. A & C Black London, Reprint 1990. Print.

Campbell, Malcolm. *The Scottish Golf Book,* Great Britain: Lomond Books, 1999. Print.

Chen, Xiangqiao, and Jianguo Wu. *Sustainable Landscape Architecture; Implications of the Chinese Philosophy of 'Unity of Man with Nature' and Beyond*. Springer Science and Business Media. Landscape Ecology (2009) 24. 1015-1026. Web. 22 November 2014.

Clark, Robert. *Golf: A Royal and Ancient Game.* Macmillan & Co. 1893 edition. 1975 Rpt. EP Publishing. Print.

Cleveland Metroparks. *Acacia Reservation; Ecological Restoration Master Plan*. Project Consultants; Biohabitats. May 2014. Web. 8 February, 2015.

Colding, Johan and Carle Folke. *The Role of Golf Courses in Biodiversity Conservation and Ecosystem Management*. Ecosystems 12, 2009. 191-206. Web. 15 May, 2015.

Conant, Blake Jeffrey. *Bankrupt Golf Courses: An Historical Analysis and Strategies for Repurposing*. Submitted to The University of Georgia, 2013. Print.

Crompton, John L. *Designing Golf Courses to Optimize Proximate Property Values.* Rutledge. Managing Leisure 5, 2000, 192-199. Web. 14 November, 2014.

Cupp, Bob, Ron Whitten, and Michael C. Trimboli. *Golfs Grand Design; The Evolution of Golf Architecture in America*. Companion book to the PBS Television Special of the same name. 2012. Print.

Darwin, Bernard. *The Golf Courses of the British Isles*. Tri-Horn International, 2012. Print.

Doak, Tom. *The Anatomy of a Golf Course: The Art of Golf Architecture.* United States: Burford Books, 1992. Print.

Dodson, Ron and Bill Love. *Links to Sustainability*. GolfCourseIndustry.com, June, 2012. Web. 4 April 2014.

Dodson, Ronald G. *Managing Wildlife Habitat on Golf Course*. Sleeping Bear Press, 2000. Print.

Fall, Juliet. *Divide and rule: Constructing human boundaries in 'boundless nature'*. Springer, 2014. GeoJournal, Vol. 58, No. 4, Political Ecology, Territoriality and Scale, 2002. 243-251. JSTOR. Web. 11 February, 2014.

Gieseking, Jen Jack, and William Mangold. *The People, Place, and Space Reader*. Routledge Publishing, 2014. Print.

Ginsberg, Joshua R. "Spatial Scale and the Design of Conservation Interventions". *Designing Wildlife Habitats*. Ed. John Beardsley. Dumbarton Oaks Colloquium on the History of Landscape Architechture XXXIV, 2013. 47-64. Print.

Golf Magazine. *Golf Magazine's Encyclopedia of Golf*. New York: HarperCollins, 1993. Print.

Golicz, Lawrence J. *Golf Courses: An ever Changing Challenge*. American Society of Appraisers, 2013. Print.

Green, Ronda J. and Karen Higginbottom. *The effects of Non-Consumptive Wildlife Tourism on Free-Ranging Wildlife: A Review*. Pacific Conservation Biology, Vol 6. 183-197. Surrey Beatty & Sons, Sydney, 2000. Print.

Grimm, Nancy B., et al. *Integrated Approaches to Long-Term Studies of Urban Ecological Systems*. Oxford University Press. Bioscience, vol. 50, No. 7, July 2000. 571-584. JSTOR. Web. 18 October, 2014.

Haila, Yrjo. *Beyond the Nature-Culture Dualism*. Biology and Philosophy 15, 2000. 55-175. Print.

Haila, Yrjo. *Socioecologies*. Wiley. Ecography, Vol. 22 No. 4, Aug. 1999. 337-348. JSTOR. Web. 1 November, 2014.

Handel, Steven. "Ecological Restoration Foundations to Designing Habitats in Urban Areas". *Designing Wildlife Habitats*. Ed. John Beardsley. Dumbarton Oaks Colloquium on the History of Landscape Architechture XXXIV, 2013. 169-186. Print.

Helphand, Kenneth, I. *Learning from Linksland*. Landscape Journal 14, no. I, 1995. 74-86. Web. 6 November 2014.

Hunter, Robert. The ideal Golf Course. Masters of the Links; Essays on the Art of Golf and Golf Course Design. Ed. Geoff Shackleford. Sleeping Bear Press, 1997. 5-15. Print.

Jerolmack, Colin. *Toward a Sociology of Nature*. New York University. The Sociological Quarterly 53, 2012. 501-505. Web. 21 November 2014.

Johnson, Craig, W. *Planning and Designing for the Multiple Use Role of Habitats in Urban/Suburban Landscapes in the Great Basin*. Landscape & Urban Planning 32, 1995. 219-225. Elsevier. Web. 2 December, 2014.

Keeler, O.B. *What I saw of British Links*. Masters of the Links; Essays on the Art of Golf and Golf Course Design. Ed. Geoff Shackleford. Sleeping Bear Press, 1997. 23-30. Print.

King, Gil, and Bruce Curtis. *The Art of Golf Antiques; An Illustrated History of Clubs, Balls, and Accessories*. Running Press, 2001. Print.

Knight, Richard L., and Kevin Gutzwiller. *Wildlife and Recreationists; Coexistence through Management and Research*. Island Press, Publisher, 2013. Print.

Lacher, Iara, and Marit L. Wilkerson. *Wildlife Connectivity Approaches and Best Practices in U.S. State Wildlife Action Plans.* Conservation Biology, Volume 28, No. 1, 13-21, 2013. Print.

Langford, William B. *Why not six hole courses?* USGA Journal and Turf Management, November, 1951. Web. 18 November, 2014.

Love, Bill, *An Environmental Approach to Golf Course Development*. American Society of Golf Course Architects, 2008.

Low, John L. *Concerning Golf*. London: Hodder and Stoughton, 1903. Web. 12 November, 2014.

Macdonald, C.B. *Architecture*. Masters of the Links; Essays on the Art of Golf and Golf Course Design. Ed. Geoff Shackleford. Sleeping Bear Press, 1997. 35-49. Print.

MacKenzie, Dr. Allister. *Experts Needed; Neglecting to Employ Qualified Architects Has Cost Thousands in Municipal Course Building*, Masters of the Links; Essays on the Art of Golf and Golf Course Design. Ed. Geoff Shackleford. Sleeping Bear Press, 1997. 75-79. Print.

Martin, Gregory E. *Creating Sustainable Golf Course Developments: Golf as a Solution?* American Society of Landscape Architects, Annual Meeting and Expo, Web. 3 September 2009

Maryland Department of Natural Resources. *Maryland Wildlife Diversity Conservation Plan*. Annapolis MD, September 2005. Web. 10 December, 2014. www.dnr.maryland.gov

Mullins, Philip M. *A Socio-Environmental Case for Skill in Outdoor Adventure*. Journal of Experiential Education Vol. 37 (2), 2014. 129-143. SAGE. Web. 10 December, 2014.

National Golf Foundation. Closed Golf Courses: What Happens After the Final Shot is Played? ngfdashboard.org 2014. Web. 5 November 2014.

Oehler, Covell, et al. *Managing Grasslands, Shrublands, and Young Forest Habitats for Wildlife; A Guide for the Northeast*. The Northeast Upland Habitat Technical Committee Massachusetts Division of Fisheries & Wildlife, 2006. Print.

Pickett, S.T.A, M.L. Cadenasso, and J.M. Grove. *Resilient Cities: Meaning, Models, and Metaphor for Integrating the Ecological, Socioeconomic, and Planning Realms*. Landscape and Urban Planning 69, 2004. 369-384. Science Direct. Web. 12 November, 2014.

Plumwood, Val. *The Concept of a Cultural Landscape: Nature, Culture, and Agency of the Land*. Ethics & the Environment, Volume 11, Number 2, 2006. 115-150. Project Muse. Web. 27 October, 2014.

"Recreation." Def. 1,1a,1b. Merriam-*Webster's Dictionary*. Web. 6 December 2014.

Shakleford, Geoff. *Grounds for Golf: The History and Fundamentals of Golf Course Design*. New York: Thomas Dunne Books, St. Martin's Press, 2003. Digital (kindle).

Silvern, Steven E. *Uncommon Ground; Toward Reinventing Nature*. Ed. William Cronon. Geographical Review; Oct 1996; 86, 4; Proquest Environmental Science Collection, 613. Web. 16 November 2014.

Stairs, David. *Biophilia and Technophilia: Examining the Nature/Culture Split in Design Theory*. The MIT Press. Design Issues, Vol. 13, No. 3, 1997. 37-44. JSTOR. Web. 1 November, 2014.

Tillinghast, A.W. *The Ideal Course: Rugged and Natural*. Masters of the Links; Essays on the Art of Golf and Golf Course Design. Ed. Geoff Shackleford. Sleeping Bear Press, 1997. 68-72. Print.

Wang, Zhifang. *A Combined Design Approach for Integrating Habitats in Mixed-Use Development*. The University of Michigan, 2008. Web. 3 November, 2014.

Wood, Mike. *Sustainable Masterplans*. European Institute of Golf Course Architects, 2014. EIGCA.org. Web 17 March, 2014.

Yu, Kongjian. *The Art of Survival*. Mulgrave, Victoria: Images Publishing Group, 2006. Print.

Yu, Kongjian. *Landscape as Ecological Infrastructure for an Alternative Urbanity*. Archnet.org. Web. 8 December 2015.