8-2020

Resilient Golf Course Design: Renovating Eaglewood Golf Course to Improve Stormwater Management & Increase Wildlife Habitat

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Acknowledgements

A huge thank you to my committee members: David Evans, Dr. Ole Sleipness and Jeff Zimmerman. All three have provided me with invaluable insight and guidance throughout my entire graduate education and without them, my project would have been nearly impossible to complete.

Thank you to the Eaglewood Staff, mainly Director of Golf Brent Moyes and Superintendent Weston Kimber. Both have mentored me over the years and fueled my passion for golf course design and maintenance.

It is a difficult time for golf courses in the United States, as the interest in the game is increasing, but the costs of maintenance are increasing even more quickly. Many courses throughout the country are being forced to make difficult decisions about overall management in order to survive and combat economic challenges. The vast majority of courses in this predicament are publicly owned courses that tend to rely on smaller operating budgets. Many such public courses, specifically those owned by cities and other municipalities, are being shut down because they are unable to cover their costs.

In order to combat this issue, creative solutions will be required. Renovation of courses to remove unnecessary irrigated turf, thereby improving water conservation and management is a proven method for reducing maintenance costs while preserving playability for all skill levels. As more courses feel the pressure to save money, these types of solutions will become necessary.

INTRODUCTION

Abstract

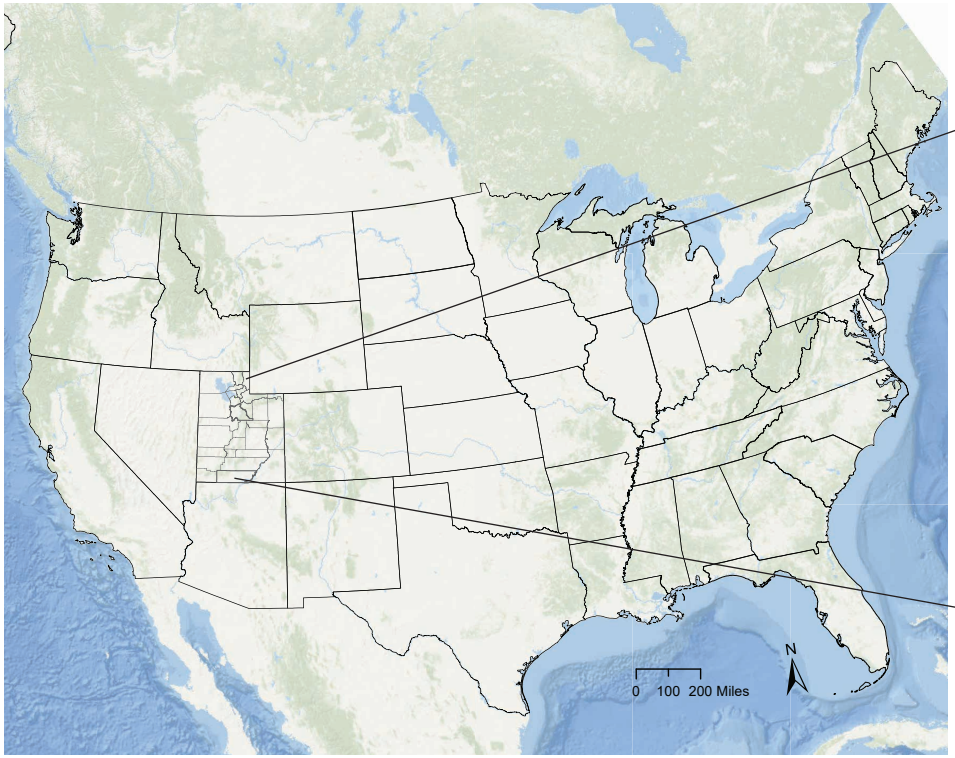
The Earth is experiencing climatic changes globally, influencing issues such as reduced water availability, loss of native habitats for flora and fauna, increased resource demand and consumption by humans, continued dependency on carbon-based energy, rapid population growth and rising global temperatures. In order to combat and mitigate these issues, changes to our design habits will be required. Historically, golf courses have been viewed negatively with regard to environmental impacts, due to excessive water use, reliance on herbicides and pesticides and the carbon footprint associated with mowing. However, recent studies have shown that golf courses have the potential to positively impact their environment by recreating native habitats and providing on-site stormwater management to reduce water needs (Kohler, Poole, Reicher, & Turco, 2004) (Hodgkison, Hero, & Warnken, 2007). Recent changes in the culture of golf course management have led to a shift toward becoming environmental stewards. One of the areas most affected by climate changes is the Upper Mountain/West region that includes Utah, Colorado, Idaho and Wyoming.

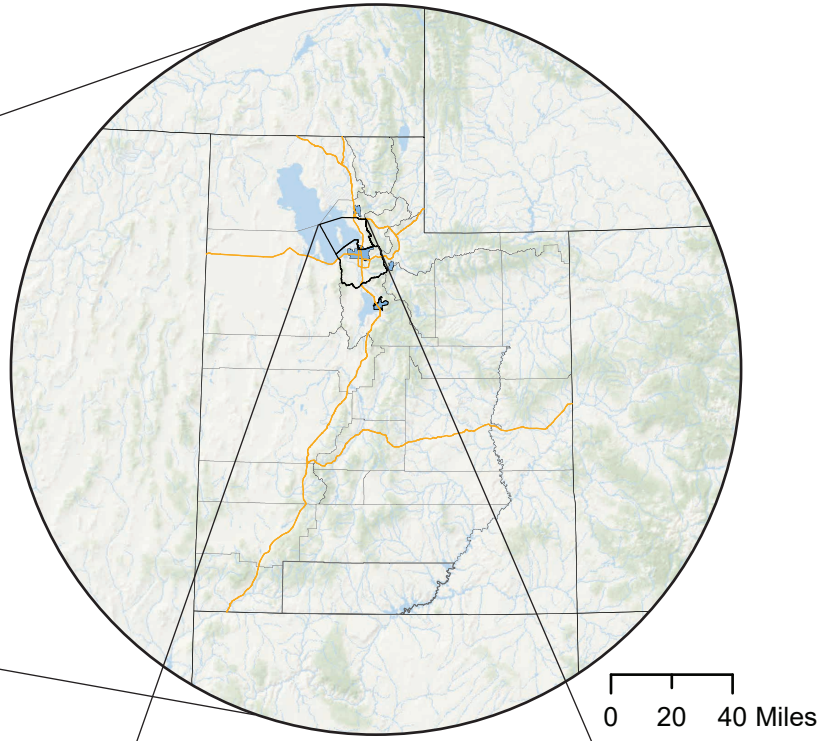
Executive Summary

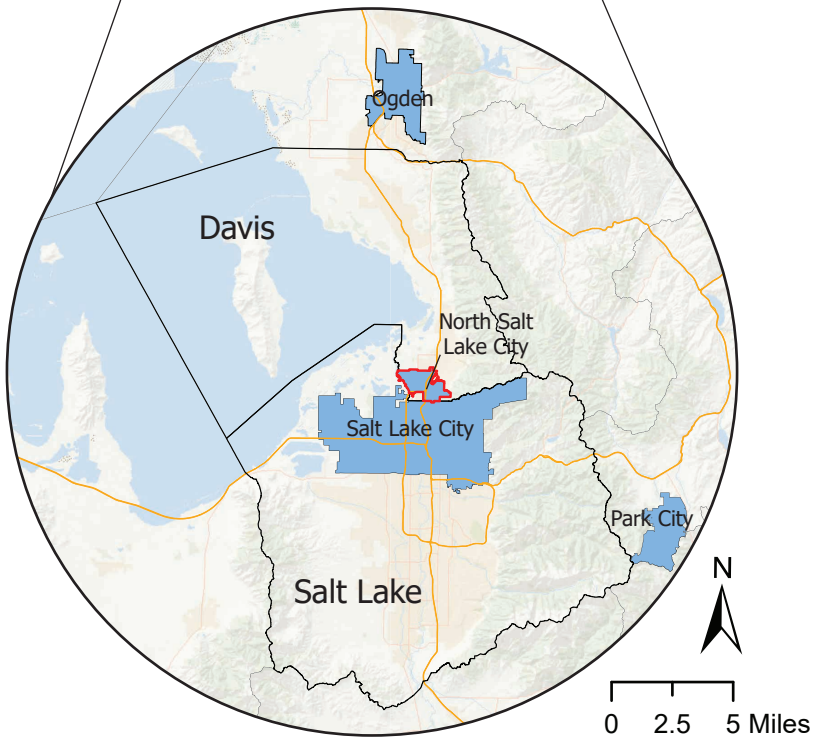
This plan B thesis is a proposal of design renovations for Eaglewood Golf Course, located in North Salt Lake City, UT, with an emphasis on creation of native habitats and improving on-site stormwater collection for the course. Renovations to existing golf courses can benefit the native flora and fauna by creating suitable habitats in both urban and residential settings. The golf course benefits from the reduced water usage and maintenance costs.

This design plan emphasizes the unique character and opportunities that Eaglewood's location and current architecture provide. These renovations will prioritize "out-of-play" areas of the golf course, which excludes tee boxes, fairways and greens, but could expand to these areas if necessary. The main wildlife species that would be attracted to said "out-of-play" habitats are insects and birds. An emphasis will be placed on reducing irrigated turf area, replanting native species, and creating wetland networks.

By accommodating these renovations, Eaglewood can expect to have a more biodiverse population of flora and fauna, as well as, an improved ability to collect and filter runoff, from both the course and surrounding residential communities. Such runoff may be reused during the peak demands of summer and become an example of modern sustainable golf course design. The design renovations would help enhance Eaglewood's reputation in the local golf community as a water-wise and ecofriendly facility and would provide long-term habitat for many plants and animals that live in the surrounding mountains.



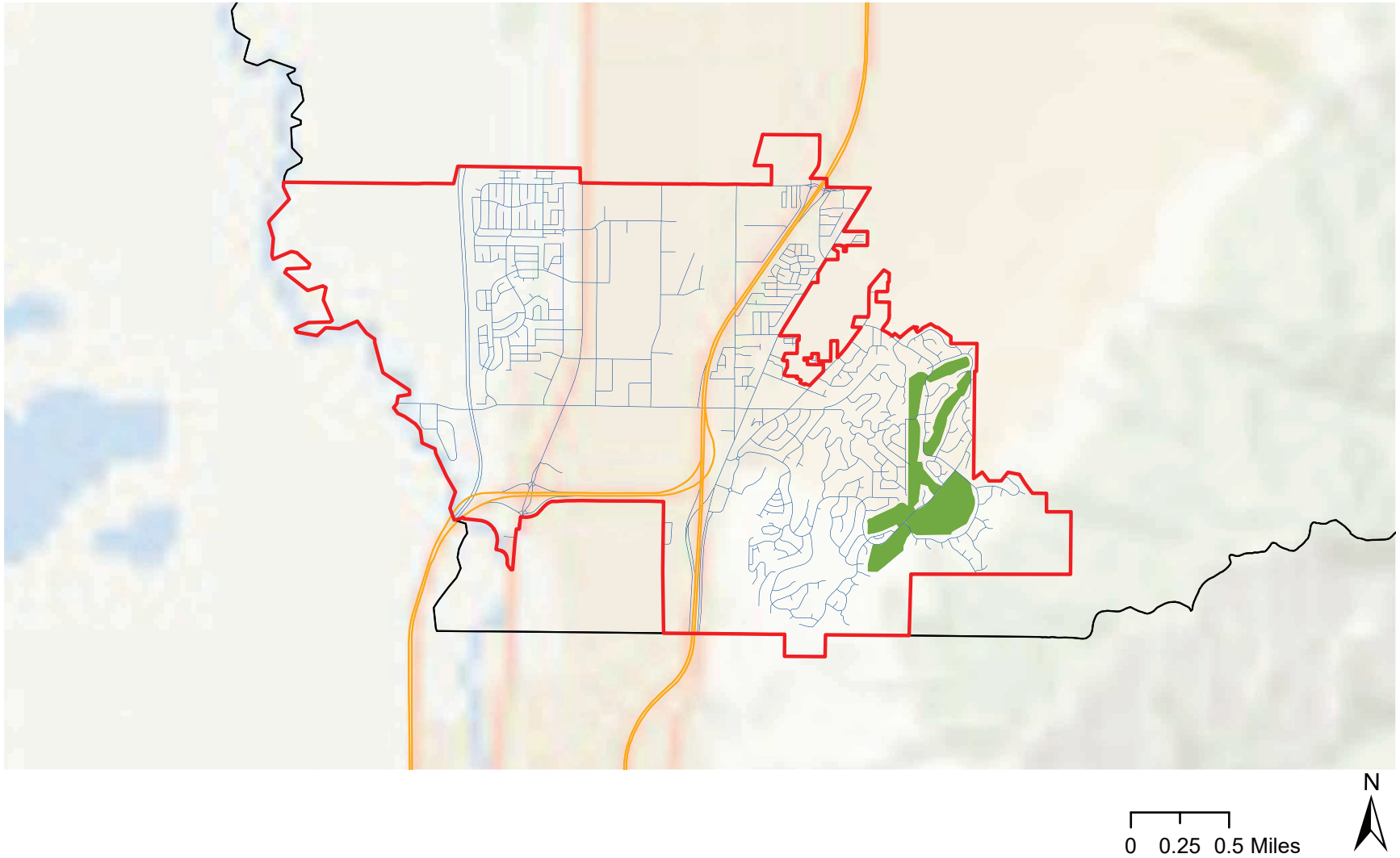




Context Mapping

Eaglewood is located in the western United States, in the city of North Salt Lake City, Utah. The majority of the development and people within the state are located in northern Utah, specifically the Wasatch Front, an area that runs parallel to the Wasatch mountain range to the east and is bounded by the Great Salt Lake to the west.

North Salt Lake City is in Davis county and borders Salt Lake county to the south. It is approximately 30 miles south of Ogden and 38 miles northwest of Park City. The city is bisected by I-15, the main highway running north/south in Utah.



Eaglewood is located on the eastern edge of North Salt Lake City. It is surrounded by residential development located on the slopes of the Wasatch mountains.

The course routing is interrupted by multiple residential roads, breaking the course into sections of multiple holes. The back nine routing creates a loop on the northern section of the course. The south section of the course is clustered together and runs east to west along a ridgeline.

North Salt Lake City History

In 1930 most local residences and businesses were located west of Highway 89/91. About sixty-five homes stood on the hillside above. The main source of water came from the natural springs that flowed out of the hillside.

In 1946 a developer purchased land on the hillside to build homes. In order to obtain water for his homes he made a purchase agreement with the owners of the McDuff and McNeil springs. This concerned the landowners west of the highway as they were not allowed any additional water from the springs. Because of this concern, a handful of citizens formed a committee with the express purpose of preparing a petition to form a town in order to instigate control of the water system.

On 3 September 1946 the Davis County Commission granted the area status as an incorporated town. North Salt Lake took its name from the name of the small post office at the railroad tracks. The old Utah Highway Patrol weigh station was purchased and used as the first town hall. In 1949, North Salt Lake held its first election, selecting Ray Hatch as mayor.


North Salt Lake City City Hall building

Demographics

	Population	Female %	Minority %	Median Income	Land Area
North Salt Lake	20,850	50.6	15.9	$79,519	8.52 Mi²
Utah	3.16 Million	49.6	9.3	$68,374	82,169 Mi²

Sources: US Census Data & North Salt Lake City

Eaglewood's History & Character

Eaglewood is owned by North Salt Lake City. An eighteen-hole golf course built over an old gravel pit in 1995, Eaglewood was originally a private country club. However, in the early 2000's the course opened to the public and has remained so ever since.

The course is located in a cove around the point of the mountains leading into Salt Lake City. This location lends to frequent windy conditions and the course was designed to take advantage of this factor. The course is a parkland style design that is challenging and exciting for all skill levels.

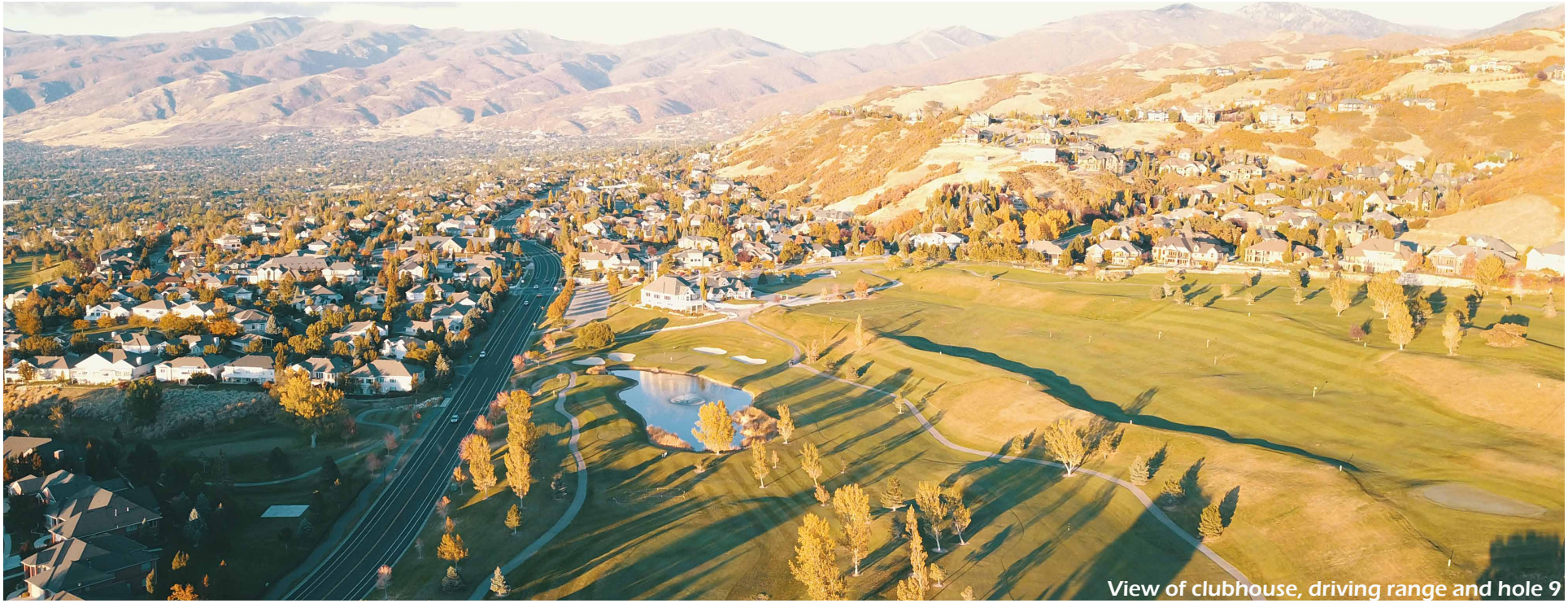
The holes closest to the clubhouse and driving range are located in a large basin. The majority of the back nine are located below Eaglewood Drive, heading directly down the mountain side and then returns back up. Above the basin is a section of 5 holes with the best views of the Wasatch Front.

71
Par

6771
Yardage

5267
Highest Point (ft)

4809
Lowest Point (ft)



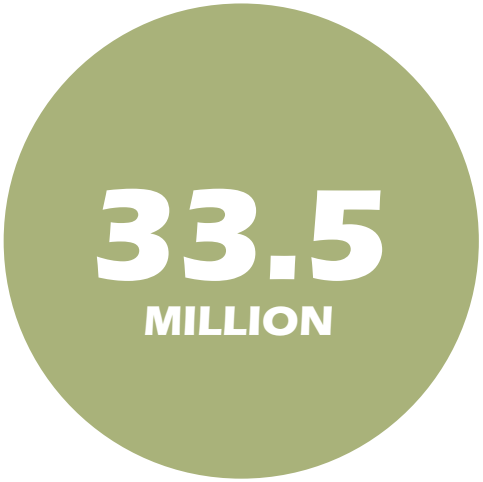
View of clubhouse, driving range and hole 9

The Current State of Golf

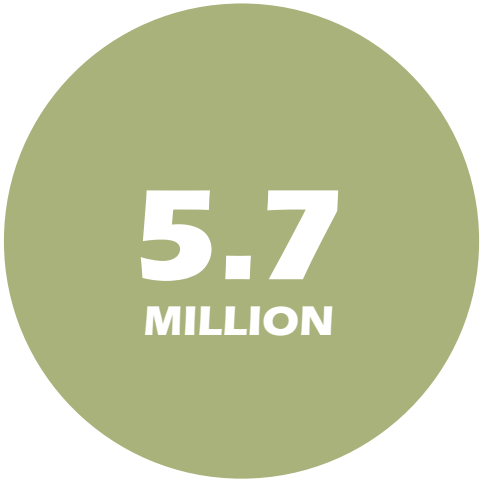
Golf is a game enjoyed by a wide variety of people. One of the game's most unique draws is the fact that it can be played from youth through older adulthood. Initially established in the United Kingdom, golf courses can now be found in every corner of the world. However, current American golf courses hardly resemble the games British origins when courses were created within the natural coastal landscapes rather than built to specifications.

While participation is continuing to increase, the game of golf is not without its challenges. Courses require a large piece of land in order to be built to typical length. Thus, as society continues to rapidly expand all forms of development, golf course construction in the United States has begun to slow down. Another issue is the expense required to play a round which can make it difficult for many to access their local courses. That being said, organizations like the United States Golf Assocation, the Professional Golfers Association of America and the First Tee are working hard to find ways to make golf more appealing and accessible to all people.

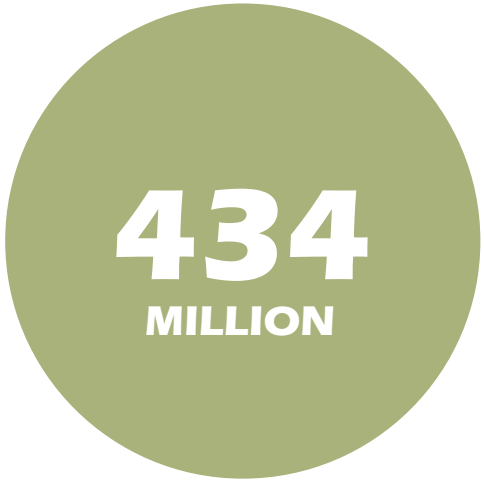
Looking forward, golf courses will face some difficult environmental challenges. Resilient design and management thinking will be required to solve these challenges and keep course fees down, as increased participation by a diverse group of people can will help golf withstand any future challenges.



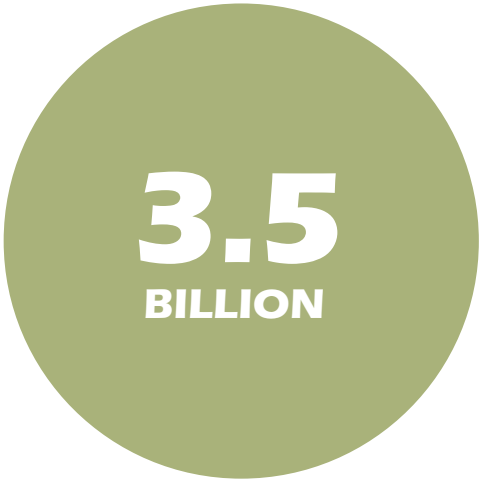
Number of Americans aged 6+ who played a round of golf in 2018
(includes off course faciliites)



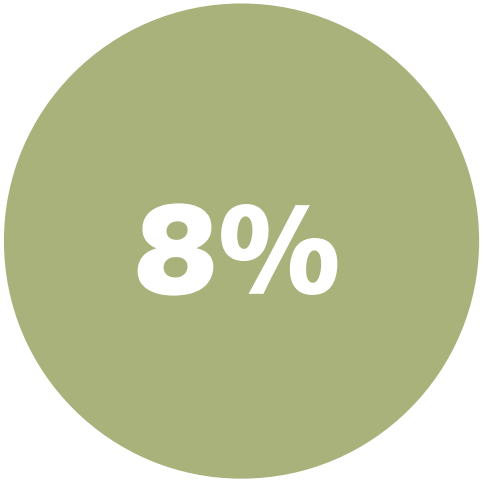
Number of female golfers aged 6+ in 2018. Makes up 23% of all golfers



Total number of rounds played in the United States in 2018



Dollars invested into golf course renovations since 2006



Decrease in new golf course construction since 2006

Of United States golf facilities are open to the public

[15]Source: National Golf Foundation

History of Golf

Breaking down the history and evolution of golf as a whole is complex. In order to simplify matters, this document will examine golf from two regions, Scotland and England, followed by the origins of the game. We will also examine American golf, which includes many fundamental British principles in addition to American concepts in order to analyze and discuss the game's various similarities and differences throughout time.

Golf's beginnings are traceable to Scotland in 1457, when the game was first referenced in a ban by the Scottish parliament for serving as a distraction from archery practice. The ban stood until 1500 due to an ongoing war with England. (Wheeler & Nauright, 2006) It should be noted that other cultures played games very similar to golf that are traceable to much earlier times, such as the Chinese game Chuiwan, which translates to "hit ball"; traceable to the 12th century. (Browning, 2018) The Dutch also played a game called Coif, similar to hockey, that they have claimed is the origin of golf. (Gershkovich, 2017)

Golf was originally reserved for royalty and resulting in the term "the royal and ancient game" a phrase that is still referenced to this day. The game is a symbol of the union between England and Scotland. In the mid 1700's, exclusive clubs were formed, which separated the classes and allowed wealthier people to pay for access to courses at their leisure. This idea of exclusive grouping was derived from the recently formed political parties in England.

Quickly following the formation of exclusive clubs emerged the idea of tournaments. The first golf tournaments determined who would be the head of the club for the following year. (Browning, 2018) Until the year 1744, each golf course played by its own rules. Some of these rules included the creation of hazard areas, penalty strokes, hole routing for consistency of score, etc. Course etiquette was first introduced in 1783 leading to the unwritten rules that still govern golf today. Some of these unwritten rules include, the furthest ball from the hole plays first, don't make any noise while someone is swinging, and maintain honesty and integrity in scorekeeping. In 1898, the handicap system was first developed, which kept a record of a players scores throughout the year and established a number of strokes that a player would receive in relation to their competitors.

This system leveled the playing field for all players and allowed both skilled and less skilled players to play competitive matches against one another. This idea was originally met with skepticism, but it has since been accepted by all courses and contributed to the explosion of interest in golf. These major regulation changes are still in place to this day and have been adopted globally. In the early 20th century, the English economy began to explode resulting in middle- and lower-class citizens with more disposable income than ever before. They quickly took interest in the "royal and ancient game" that had largely excluded them to this point, leading to the creation of more courses and a rapid increase in popularity of the game. (Ceron-Anaya, 2010)

The first golf course in the United States was St. Andrews. established in New York in 1888. The game initially interested wealthy Americans because of its relaxing nature and safety in comparison to the typically played games, cricket and polo. In the United States, the game of golf is closely tied to business interests, as American companies spend billions of dollars on golf each year. The casual nature of the game makes it a good environment for relationship building and business deals. The length of time required to play also allows plenty of time to get to know your playing partners and recognize their emotions and reactions to good and bad shots. The gradual gentrification of the game also played directly into businesses best interests. Taking a potential client golfing was viewed as a show of financial power, thus the more exclusive and prestigious courses that you had access too, the better the impression. (Ceron-Anaya, 2010)

Differences in the perceptions of golf in Great Britain and the United States have led to very different outcomes with regards to course design. Golf course architects, like any other professionals, design courses that best fit the interests of their clients. This gap in perception has become more obvious over time and continues to change to this day.

Golf Course Design History

The game of golf was originally shaped by the land. There were no routing or courses–people simply brought their equipment and played to wherever they chose. The most notable course from this era is St. Andrews, still located on the sandy coastal dunes of Scotland. The course includes hilly fairways, bunkers everywhere you look, and no trees in sight. There were neither professionals nor greenkeepers taking care of the course, as it was managed by the sheep populations that grazed the grassy hills. Original bunkers were formed by burrowing sheep, seeking to hide from stiff coastal winds. (Browning, 2018) In effect, the course functioned as a public park, that happened to include a golf course. The St. Andrews of today looks like a typically managed golf course but the design continues to be entirely natural. Despite the high demand to play from a global clientele, the course still closes on Sunday's and reverts to its original use as a park. The majority of courses in Scotland and England were created with similar mindsets.

Courses in the United States, however, are designed to create a feeling or experience for the player. This ideology directly conflicts with the British concept of a much less invasive design. This may be related to the television coverage of the Masters golf tournament, held at Augusta National Golf Club in Augusta, GA each year, exposing the country to the beautiful, perfectly managed course that was hidden in the Southeast. (Wheeler & Nauright, 2006) Architects caught on to the popularity of the course and attempted to recreate these forms across the country. This led to designs that paid little attention to the native environments of a property and instead altered the landscape to the desires of the architect.

The perception of that game and its courses were shaped by the land remained prevalent throughout Europe, as the game expanded its boundaries. Yet such expectations for a golf course are very different from American expectations. In Europe, brown or yellow fairways are normal as that is how the sites looked naturally. Yet in the United States such aesthetic expectations are very different. In contrast, lush green turfgrass is expected and anything other than green is considered dying or poorly managed. This can lead to major differences in course management as well as different environmental outcomes. American golf courses tend to require more water and chemical inputs in order to meet their high expectations. This

results in a larger carbon footprint.

Each golf course is its own unique composition, with each hole a unique composition of its own. The green is the focal point of each hole, as it is the player's objective. Holes can be categorized as strategic, heroic and penal, and can be natural, man-made or man-modified. A variety of tee locations can be found on every course to accommodate a wide range of skill levels. The total length of a hole affects the par and the length of the approach shot into the green, which is a major differentiation between skill levels of players. (Graves & Cornish, 1998)

In 1996, the major governing body of golf in the United States, the USGA (United States Golf Association) released their Environmental Principles for Golf Courses in the United States. This was a major announcement, covering everything from sustainable course management and construction to design and planning considerations. Under the design section of the document, the first principle was to identify existing ecosystems. Other principles include identifying natural resources, keeping existing vegetation where possible, and designing irrigation and retention systems to be as efficient as possible. (USGA, 1996) This was one of the first examples of a major governing body placing emphasis on sustainable golf course design. Twenty three years later, there are still many courses that have been built without consideration for these recommendations and in these instances, renovation is required. There could be many reasons why the USGA guidelines weren't followed–they are expensive, time consuming and difficult. Yet this is the future of golf course design–a fusion of landscape ecology, resilient design principles and classic recreational design.

Golf Course Maintenance

As late as the 1960's, golf course superintendents denied that their work could have impacts on the surrounding environment. However, that mindset has changed over time and golf course superintendents are now viewed as stewards of the environment. The Golf Course Superintendents Association of America (GCSAA) has placed increased emphasis on educating members regarding sound environmental practices, including improving the precision of chemical applications, reducing irrigation in low stress times and promoting the creation of Integrated Pest Management (IPM) programs for golf courses. Nowadays, certification is also required to become a superintendent. (Millington and Wilson, 2013) In order to reduce the inputs that high-use turf areas require, superintendents are currently researching alternative solutions. Many superintendents use best management practices (BPM) to minimize pesticide and fertilizer usage wherever possible. (Davis & Lyle, 2002)

It is estimated that there are 1,198,381 acres of irrigated turf in United States golf courses. This directly impacts the maintenance budgets of these courses, as the more water required, the higher the budget must be. The regions of the United States most susceptible to

water shortages are the Southwest and Upper West/ Mountain regions. This includes the following states; Utah, Colorado, Wyoming and Idaho in the Upper West/Mountain region and Arizona, New Mexico, Nevada and Southern California in the Southwest region. (Lyman, Throssell, Johnson, Stacey & Brown, 2009) That being said, lessened disease pressure is one benefit of the climates in these regions due to arid conditions, meaning lack of humidity and cool overnight temperatures. Superintendents in these areas have expressed an interest in reducing synthetic inputs due to lower threat levels but there aren't many incentives to do so currently. (Johnson, Dyke, Hodgson, Murray, & Kopp, 2012) However, as temperatures warm year by year, these areas are experiencing

more frequent warm overnight temperatures. Warm overnight temperatures are considered to be 68-70 degrees Fahrenheit and above. This can lead to snow molds on greens when they come out of dormancy, or the growth of unwanted weeds such as poa annua or annual bluegrass, which are very difficult to remove.

Another major issue in golf course management is how to deal with runoff entering wastewater systems. Runoff from golf courses can contain traces of pesticides and fertilizers that are necessary for management but harmful if introduced at high levels to stormwater drains and surrounding water bodies. (Davis & Lyle, 2002) Keeping as much of this runoff on site as possible will limit the exposure of these systems to high nutrient levels that could be harmful in extreme cases. If collected in wetlands or retention basins, the course can then reuse this water for irrigation and as a feature of the course.

Only 20-30% of golf course property is maintained to specific golf criteria–these areas include greens, tees, and fairways. Turfgrass provides many benefits, including soil erosion control, protection of surface water quality, improved biodegradation of chemicals, soil improvement and restoration, temperature modification, habitat provisions for wildlife, a decrease in noxious weeds and pests, enhanced physical and mental health for users, and enhanced beauty and aesthetics. (Beard, 1994) The other 70-80% of a golf course property has potential to make a major impact on the resiliency of the golf course. Collecting stormwater, limiting irrigation needs and providing habitat for native wildlife can make a course an environmental asset as well as a recreational destination.

Ecological Design

Ecological design principles are becoming more important each year, as the Earth experiences increased climatic changes. One of the main concerns of climate change is the loss of global biodiversity. Half of the world's population lives in urban areas disconnected from nature. Unfortunately, education-based approaches to biodiversity aren't effective enough and often create a sense of helplessness. Blending nature into the built environment is one possible way to reestablish the connection between man and nature. Increasing peoples interaction with nature will also increase awareness and a willingness to protect and promote these types of landscapes. (Miller, 2005)

Approximately 23% of golf courses are non-turfgrass or water, which areas could potentially incorporate habitats and ecological design principles. However, there is a need to balance playability with the location of these interventions. Trees can block views and deflect errant shots, excessive leaves can make finding balls difficult and adding water to any part of the course creates another hazard for golfers to navigate. The best spots for habitat creation are around tee boxes, behind greens and between tee boxes and the beginning of fairways. (Jackson, Kelly, & Brown, 2011) Approximately 50% of golf courses have implemented some type of wildlife habitat or native planting improvements since 1996. (Lyman, Throssell, Johnson, Stacey & Brown, 2007) For instance, golf courses in Stockholm, Sweden provide 25% of the total wetland area in the city. They also contain essential conditions for amphibian life and have a large species diversity. (Colding, Lundberg, Lundberg, & Andersson, 2009)

Golf courses can provide more habitat than parks, mostly due to their large size and ability to form larger areas than a typical park could. Increases in the size and scale of a habitat area will increase the diversity

of species present in that area. (Hodgkinson, Hero, & Warnken, 2007) Also, 64% of golf courses had higher ecological values than other green spaces with other land uses. In the hierarchy of ecological land uses, golf would be located near the top but behind large natural areas like national parks, public lands, etc. Still it would be prioritized ahead of municipal parks and residential and commercial developments. (Colding & Folke, 2009)

When designed properly, golf courses can play a major role in preserving important landscapes. Golf courses in Oregon preserve oak savannahs, in New Mexico they conserve riparian areas after 95% have been destroyed, and courses in the UK are a main source for preserving heathland and coastal grasses. (Colding & Folke, 2009) One can also design to exclude certain species that can be common irritants, such as the Canadian Goose. However, golf courses usually consist of too much habitat fragmentation to be ideal habitats. For this reason, innovative design thinking is required to improve the ecological function of these large open space areas. (Terman, 1997)

For courses that cannot afford a complete renovation, there are many programs that management staff can follow to improve ecological contributions. Organizations such as the United States Golf Association (USGA) and Audubon International have created Voluntary Environmental Programs (VEP) for golf course management. These programs are common in industries such as manufacturing but are relatively new to golf. Such programs tend to be more flexible and efficient than programs designed by typical legislation. (Minoli & Smith, 2011) Some examples of practices that are being advocated in these programs include minimizing chemical usage to the most essential applications, limiting irrigation, maintaining various plant types and heights, leaving dead trees in place when possible, training all employees on cultural practices and documenting activities and results for future planning. (Audubon Society)

Water Conservation & Management

The number one environmental issue associated with golf courses is water usage. In order to keep up with the high standards required for courses, regardless of climate conditions, large amounts of water can be required to maintain a playable, durable, green property. As of 2013, golf courses in the United States use 1.44% of all the water used for irrigation. (Gelernter, Stowell, Johnson, Brown, & Beditz, 2015) The purpose of irrigating turf areas is to supplement rain events and balance the evapotranspiration for the plant. The value provided by high use recreational areas such as athletic fields and golf courses can offset the costs of water, a value thatresidential landscapes do not provide. (Kjelgren, Rupp, & Kilgren, 2000) Private golf courses tend to be more efficient with their water usage because larger maintenance budgets allow staff to improve technology and infrastructure more frequently. Golf courses associated with residential developments tend to have the most imbalanced water budgets due to the inefficient water usage of the surrounding low-density housing. (Ortuño, Hernández, & Civera, 2015)

The hydrological cycle supplies more than enough water for our population of 6 billion people, but most of it is not usable by humans because runoff doesn't allow it to infiltrate the land and replenish reservoirs and aquifers. It will be critical to create more efficient water capture systems that will return water back into aquifers to replenish the available water supply. (Postel, 2000) Runoff from golf courses is a major source of nonpoint pollution in urban areas. (Kohler, Poole, Reicher, & Turco, 2004) Improving the collection and distribution of water on golf courses can help to reduce this impact on surrounding communities. However, just 22% of golf courses have improved their stormwater management since 1996. (Lyman, Throssell, Johnson, Stacey & Brown, 2007)

Creating retention wetlands is a proven method for managing stormwater for both the course and the surrounding residential areas covered with nonpermeable surfaces that speed up the movement of water into stormwater systems. Wetlands are typically more effective than retention basins because they are more supportive of plant and amphibian populations. Due to the constant management of golf courses,

wetlands tend to be better maintained than a retention basin. (Kohler, Poole, Reicher, & Turco, 2004) The main goal of these solutions is to manage all the stormwater on site. However, some common problems with these wetland networks are eutrophication due to the high amounts of phosphorous in many common golf course chemicals and construction mishaps that can lead to wetland failure over time. (Che, Zhao, Yang, Li, & Shi, 2014)

A recent trend in golf course management has been a shift in water sources from primary to secondary or reuse water. This limits the course's impact on potable water available for communities, but it also creates more issues for course managers and superintendents. Using reuse water for golf courses increases salinity at all measurable depths. Transfers to this water source need to be implemented slowly, or there is a risk of shocking and killing the existing plants. The ability of the superintendent to manage high soil salinity will be critical in water stressed areas like Utah. (Lockett, Devitt, & Morris, 2008)

Water quality can also be threatened by the use of reuse water. If the water isn't managed properly on site, then it will enter the stormwater system and increase nutrient and salt levels. Frequent water quality testing should be performed to monitor the levels of salt and the major golf course chemical elements; phosphorous, nitrogen and potassium. (King, Balogh, Hughes, & Harmel, 2007)

Since 2013, golf courses in the United States have reduced their water use by 21.8%, due primarily to a reduction in irrigated acres, the number of golf facilities and conservation practices. Conservation practices include, applying more wetting agents, hand watering more often and simply keeping turf drier. The cost of water is rising steadily in all regions except the Upper West/Mountain and North Central regions. Regulations on water, however, have increased nationwide. (Gelernter, Stowell, Johnson, Brown, & Beditz, 2015)

Native Wildlife and Vegetation

Golf courses are large open space areas with a recreational purpose. However, such a purpose doesn't mean they cannot also function as habitat for native wildlife and vegetation communities. Golf courses can serve as a great space for providing habitat, but the most highly debated issue centered on golf courses is their water usage. (Tapias & Salgot, 2006) Native plant selection is one method used to help reduce necessary water inputs for a golf course. Golf courses are typically built on areas with low land value which makes them more susceptible to flooding and poor soils, disconnected from other resources. (Burgin & Wotherspoon, 2009) These harsh conditions make it more difficult for non-native plants to survive. Many golf courses use reclaimed waste water for irrigation, which also comes with a long list of problems for plant survival. High water salinity leads to salt buildup in the soil and ultimately, more water usage. (Tapias & Salgot, 2006)

In a study performed in the UK, biodiversity of a selection of golf courses was measured against the lands original use, typically as farmland. The study revealed that golf courses actually provided more biodiversity for trees and birds due to the variety of different plant types found on the course in comparison with the monocrop practices typical for the area. This is a positive sign but there are definite opportunities to improve golf course design to include habitat for pollinators, mainly bees. (Tanner & Gange, 2005) One benefit of prioritizing native vegetation and habitat creation is lowered costs per acre of installation when native plants are selected. After establishment, such plants require fewer fertilizers and pesticides because they are adapted to the climate. These plant selections will often attract pollinators to the area and do so quickly. Trees take 10-15 years to make an impact on the landscape whereas native

grasses and forbs take only 2-3 years. (Weston, 2001) The Audobon Society created a list of guidelines specific to golf courses and how they can create and manage wildlife habitats on their properties. A few of the main emphases were to maintain at least 50% of all minimally used portions of the property for natural wildlife, to connect small and large natural areas to improve wildlife movement and to maintain a water source for wildlife that includes aquatic plants. (Audubon International) While broad brush solutions are helpful, targeting specific species and creating solutions for them is much more effective. (Burgin & Wotherspoon, 2009) Golf course managers and architects have a clear opportunity to incorporate these principles into their properties to create courses that are an environmental resource rather than a detriment.

Social Perception

Golf has long been viewed as a game based on a set of principles and traditions. Whether it is the high expectations for honesty and integrity during a round, including calling penalties on oneself, or the unwritten rules for behavior during a round, new golfers often have to learn such rules on the fly. Some traditions that the game continues to carry date back to its origins in England in the 1600's, such as class exclusion, sexism and lack of accessibility. Golf doesn't inherently privilege men or women physically, but men participate at much higher rates than women. (McGinnis, 2005) Some of this is due to the game's origins, when women were forbidden to play.

The perception of exclusivity is a serious problem for the game's future. All sports are interested in increasing their participation, so appealing to more people is important for the growth of the game. Golf, however, has long been viewed as stuffy, boring, exclusive and only appealing for older wealthy people. A study was published in the late 1970's that showed that people with higher household incomes tended to gravitate to skiing, golf and tennis as hobbies. Those with lower household incomes gravitated towards football, boxing and rugby. (Wilson, 2002) This problem still exists today, but golf courses of all sizes and types are emerging that are accessible for many different types of people. As of 2019, approximately 76% of golf courses in the United States were open to the public and the average 18 hole round of golf costs $35. (Forbes, 2019) Women and children are increasing their participation in the sport each year and courses across the world are following a trend of relaxing traditional rules to make their facilities, and the game in general, more appealing. (National Golf Foundation, 2019)

On the other hand, private golf clubs continue to gain prestige and increase their dues as they attempt to attract a specific clientele of wealthier families to fund their expenses. This isn't necessarily meant to exclude the lower classes but rather allows such clubs to fund more projects, improve facilities and maintain courses to a higher standard due to increased budgets. It is my belief that because of their lack of public access, and resulting mystique, the stigma attached to such courses is often projected to all golf courses, when in reality, golf clubs comprise a minority of the overall golfing community.

Another factor that has always turned some off from playing golf is the length of time required to play. An average round of golf (18 holes) takes between 4-5 hours, and many people are so busy they simply don't have the time to play. Golf course architects have begun to respond to this critique by creating short courses and par 3 courses that mimic regulation length courses, but can be played much more quickly than a full length 18-hole course. As renowned golf course architect Michael Hurdzan wrote in his book Building a Practical Golf Facility, "There is absolutely no reason why golf cannot return to its roots, and ignore modern conventions in order to allow all people an opportunity to learn and experience the magic of playing golf". (Hurdzan, 2005)

Interestingly, there has been a sharp decline in participation in the United Kingdom, where many of the game's traditions began. Keith Pelley, the European Tour's chief executive recently challenged clubs in the UK to think differently and try to engage wider groups of people in order to become more appealing. (Guardian, 2017)

While the golfing community cannot force anyone to pickup the game and enjoy it, it can shift its attitude towards many who are against playing by simply becoming more inclusive and relaxed. Yet if the entire community doesn't embrace the feedback received from uninterested people, the game that so many love and enjoy will continue to be viewed as less than the sum of its parts.

Case Studies

https://giantbomb1.cbsistatic.com/uploads/original/0/1992/1750407-pinehurst02.jpg

Pinehurst No. 2 is one of the most famous golf courses in the United States. Located in Pinehurst, North Carolina, it is one of 9 different 18 hole courses at the Pinehurst Resort.

No. 2 first opened in 1907 and has hosted many of the world's largest tournaments, including 3 US Opens, as recently as 2014, 2 Tour Championships, 3 US Amateur Championships, 1 PGA Championship and 1 US Womens Open.

This resume would lead most to believe that the course was untouchable as it was but in 2010 the design firm of Bill Coore and Ben Crenshaw undertook an extensive redesign of the course to restore it back to its original intent. Throughout the years, minor adjustments had been made to the layout, including lengthening tees and adjusting greens, but these renovations paled in comparison to what Coore and Crenshaw undertook to accomplish.

https://www.pinehurst.com/content/uploads/2018/09/No4_7_2-1000x563.jpg

The main objective of Coore and Crenshaw's project was to reinvolve the natural characteristics of the course that were critical to its original design, by Donald Ross. The main methods for accomplishing this were:

- Increasing fairway widths, sometimes by up to 50%
- Removal of all rough to create two heights of grass
- Reintroducing 35 acres of natural areas
- Adding over 200,000 plants back into natural areas
- Removal of 650 irrigation heads due to reduced irrigated turf

All of the above methods helped shift the course from a large green parkland into a much more resilient and interesting layout. The restoration was completed in time for the 2014 US Open and the USGA used the course as an example of how to reduce water usage while still providing a challenging test of skill.

Case Studies

https://www.olympic.org/Global/Images/News/2012-03/08/Rio_Golf_BIG.jpg

Built by architect Gil Hanse as the host course for the 2016 Olympic games held in Brazil, this golf course is a great example of how architects can design a championship caliber venue while also preserving and creating large amounts of wildlife habitat. Some of the statistical measures of this courses ecological success include:

- Transplanting 15,000 species of vegetation and wildlife, which restored 81 acres of habitat.
- Re-naturalizing habitat which led to the increase of fauna species from 118 to 263.
- Sourcing 90% of the material used in construction from within 250 miles of the site
- Creating 3 environmental education centers in association with the course.

The course was created as a portion of a larger master plan for Rio de Janeiro focused on sustainability. Before construction, over 80% of the project area was degraded sand mining land.

https://sustainable.golf/get_involved/developments/projects/westcliffs

Working closely with the local government to ensure minimal disruption to the coastal habitats on the projects site, Cynthia Dye was able to create a beautiful golf course along the coast of Portugal. The course distinguishes itself with its oddly shaped bunkers. These shapes were dictated by the existing vegetation. Some other successful aspects included:

- Revealing 37 acres of rare coastal habitat by removing dense pine plantation.
- Creating a system of irrigation capture that collects 100% of surface water for reuse on the course.
- Using native plants to create seed banks that were then repopulated on site.

Overall, the course has received great reviews from both players and locals alike. It has a minimal impact on its environment and is bothchallenging for better players and fun for less-skilled players.

Methodology

Inventory and Analysis:

GIS Analysis

Using Geographic Information Systems (GIS) for large scale analysis, these maps visualize how North Salt Lake City and the Eaglewood golf course fit into the greater context of Salt Lake and Davis counties and their surrounding areas. GIS data layers include: slope & aspect layers to further reveal the topography of the region. Current wildlife habitats (Rocky Mountain Elk and Mule Deer) are included to explore potential connections that can be created within this project. Existing golf course and park networks reveal where and how Eaglewood fits in with other greenspaces within the counties. The land ownership layer highlights various land types in the area and which agencies own them. The soil layer helps to describe the many different soils the course was built on, which can lead to issues in managing the course and its stormwater runoff. Wetland networks and wildlife-urban interface layers describe the current stormwater collection areas and the edges of interaction between existing urban development and wildlife habitats.

Elevation Change Visualization

Using Google Earth Pro, the elevation change from the highest to lowest point of Eaglewood provides the reader with valuable perspective regarding the durastic elevation changes across the course.

Course Photos

Following the context maps are course photos taken with a university drone. These images show Eaglewood and some of the views from the course to help the reader better connect with the course, especially those who have never played there. Without these images, it would be very difficult to understand the topography and character of Eaglewood.

Local Climate Information

Next, climate information recorded from the nearby Utah State Climate Center weather station is displayed focusing on yearly precipitation levels and temperatures. This information is critical to this project because it emphasizes the vast seasonal changes that Eaglewood experiences. These extreme changes lead to some difficult maintenance conditions but also provide potential opportunities for habitat creation and stormwater management during major snowmelt runoff periods.

Digital Diagramming

Hand-drawn digital diagramming will be used for the site-scale analysis. A change to hand-drawn diagrams will allow for a more intimate exploration of Eaglewood and its surrounding areas. While focusing on the golf course, diagramming the various roads that bisect the course into multiple sections revealed fragmentations between holes and wildife and vegetation communities. Existing vegetation types are drawn to visualize the different combinations, as well as, patches of vegetation found throughout the course. Runoff diagrams are critical for explaining the slope of various holes in order to find potential areas for stormwater runoff collection and potential problems with disruption to play and course maintenance in critical areas (tees, fairways and greens).

Existing Ecological Infrastructure

Using drone imagery as its base, this section highlights examples of areas in Eaglewood where ecological infrastructure similar to the expected outcomes of the project already exist. These examples are then used as a template for the proposed renovations.

Native Vegetation

This section covers the reasoning for using native vegetation to attract pollinators on a golf course. Plant examples are provided as well as an in-depth breakdown of the native grass seed mix used in the renovations.

In conclusion, the combination of GIS, digital diagramming and various graphical representations visualize the current state of the course and highlight potential areas for improvement.

Design Renovations:

In response to the inventory and analysis, design renovations aim to renovate certain sections of the golf course that have been identified as exhibiting good potential for improved storm water management and habitat creation or that are in serious need of said interventions. Drone imagery was taken of these different areas to provide a visual representation for the reader.

Renovation Areas

For each identified renovation, the issue for the area is identified and the proposed solution is presented. Drone images of the areas with diagrams are included for visual support.

Renovation Plan

Upon completing the individual interventions, a selection of these interventions was chosen for further exploration. This included using Photoshop to create realistic imagery of what the final outcome will be. This will help the reader understand the aesthetic to be achieved through the renovations. Section images are used to provide another graphical representation of the final renovations.

Conclusion

Finally, a summary of the renovations and their intentions serves as the conclusion of the document and ties together the introduction, inventory and analysis and design interventions. Statistical information is included, such as, amount of turf removed, estimated water saved, and amount of habitat created.

Following the summary is the bibliography citing all sources for information, quotes, and images, etc. The appendix which contains construction document examples for the renovation plan.

Purpose

The purpose of this project is to apply ecological design principles to Eaglewood Golf Course in Utah, thereby providing an example of resilient golf course renovation for future landscape architects and golf course architects working in arid climates.

Scope

This project will focus on Eaglewood Golf Course in North Salt Lake City, UT. The course is located in an arid climate near a major city. The project proposes course renovations to simultaneously improve the on-site stormwater and runoff management and to provide habitat for native wildlife, mainly pollinators and birds.

Contribution

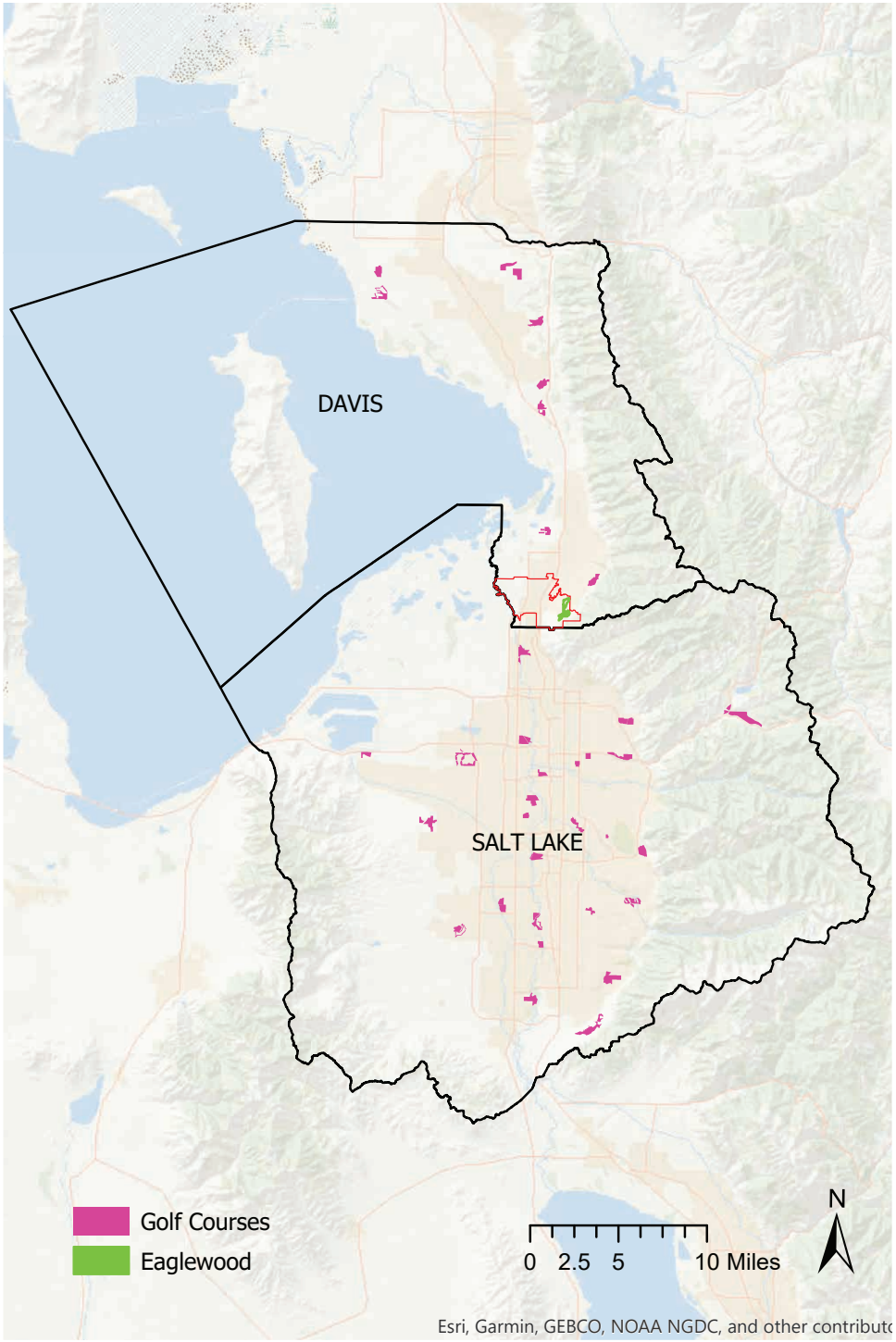
The first golf courses were dictated and shaped by the natural landscapes of the coastal lands of the United Kingdom. Originally, bunkers weren't built, they were found as natural collections of sand in depressions. Greens were not mowed, for the pin was simply placed wherever it made sense on a given day. Irrigation was not installed throughout a property; rather, natural precipitation provided the water supply. These traditions continued for many hundreds of years in the U.K. golf community.

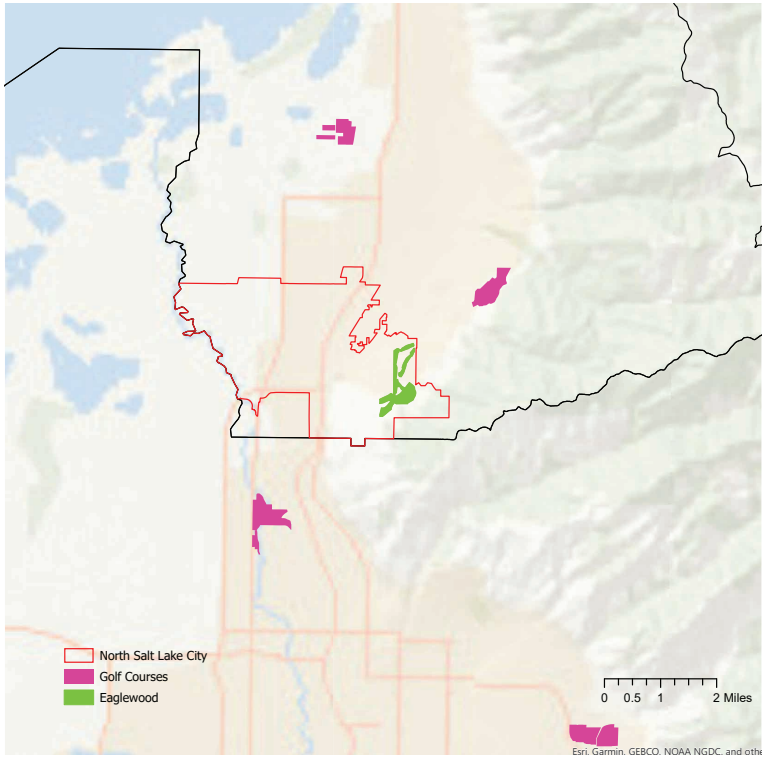
At some point, golf courses began to appear in the United States and as with many other aspects of British culture, Americans modified them to their liking. Today, golf courses in the United States consist of perfectly manicured, lush turf. However, this rise in expectations and management comes at a cost–in this case, that cost is often excessive water usage, increased use of chemicals and incredibly high maintenance costs.

The American perspective regarding golf courses can be summed up rather succinctly, "green is good and brown is bad". Yet any agronomist would tell you that this is not the case. Turfgrass has a growth and dormancy cycle that we try to combat with irrigation and chemicals to keep our desired aesthetic. But what if this weren't the case? What if one could create a beautiful golf course that required minimal inputs?

In order to begin to change the mindset of the American golfer, we need examples of successful golf courses that embrace environmental design thinking while still providing an enjoyable golf experience. This project will contribute an example of how existing golf courses can be renovated to reduce their environmental impacts and embrace the origins of the game, when golf was played on the natural terrain.

INVENTORY & ANALYSIS

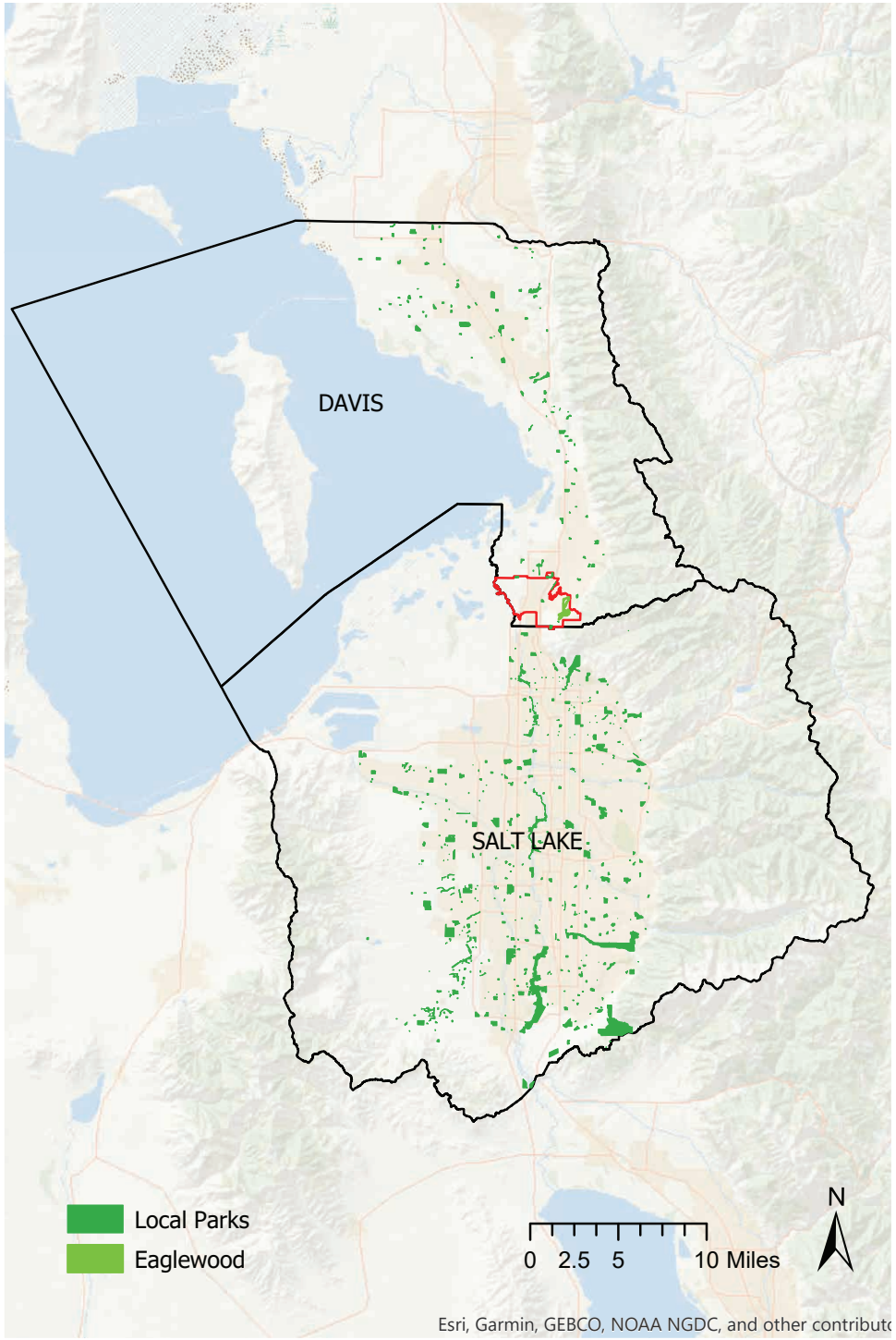


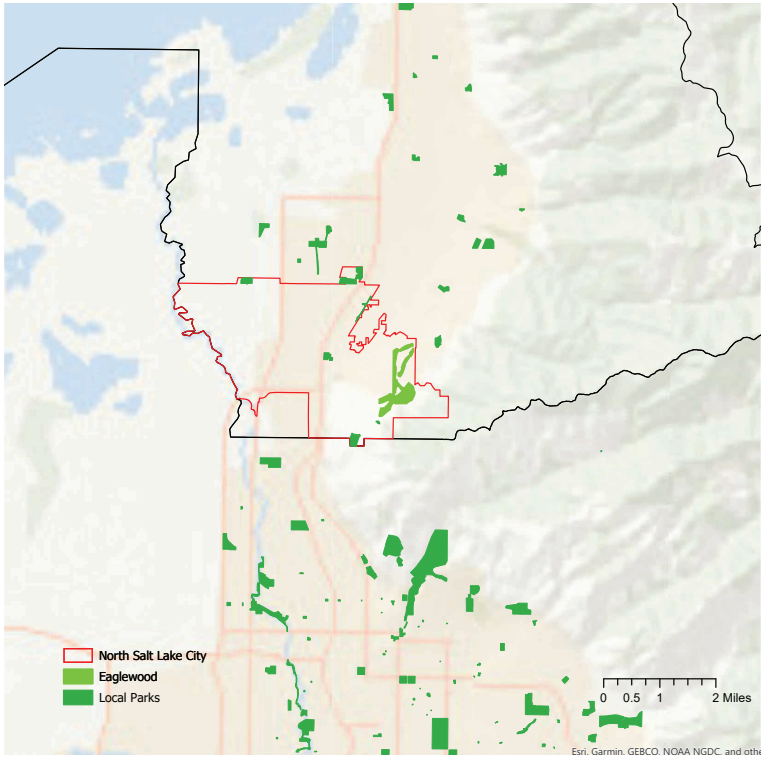


Golf Course Network

Davis and Salt Lake County host a total of 37 golf courses. Eaglewood is located on the southern edge of Davis County and is centrally located amongst the courses within the two counties. The majority of the courses are located in the Wasatch Valley floor, however, Eaglewood is built on the side of the Wasatch Mountains.

Eaglewoods closest neighbors are Bountiful Ridge, Lakeside and Rose Park. These courses are very popular and draw large numbers of players from the nearby communities.

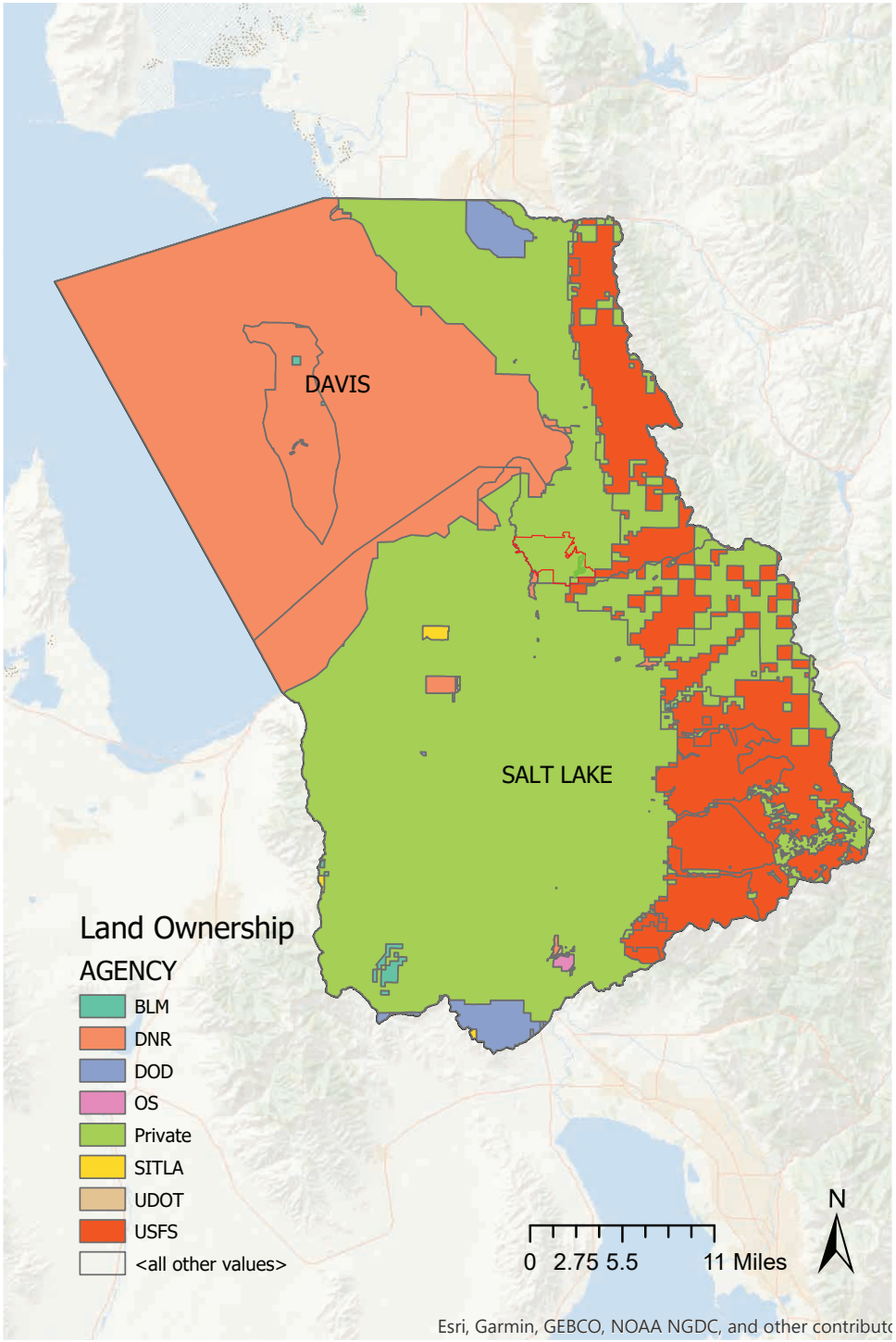


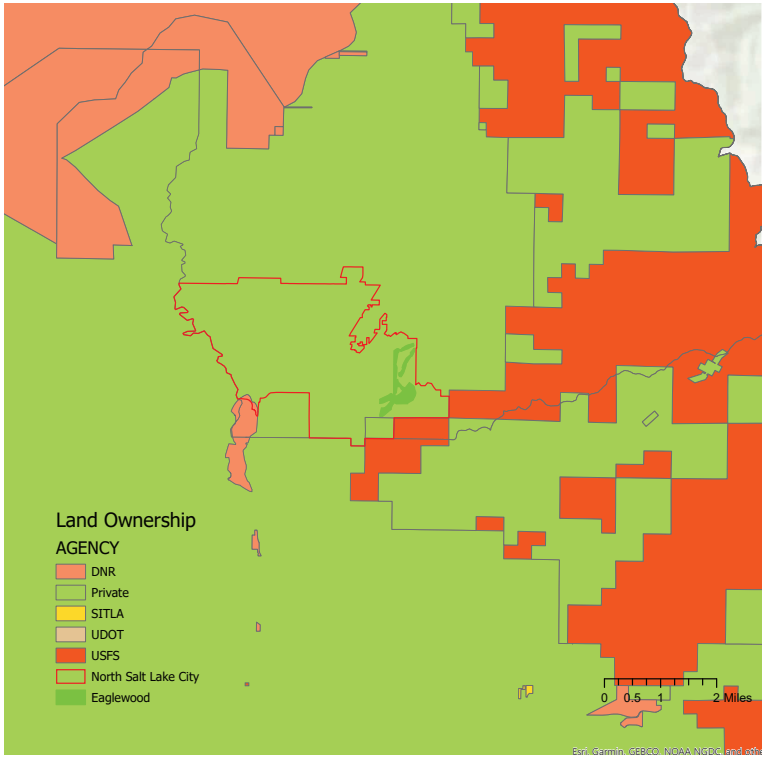


Local Park Network

Salt Lake and Davis County include combined parks. These greenspaces provide the public with places to recreate in ways other than golf. Accessible parks for the citizens of the Wasatch Front are essential to fostering healthy and liveable communities.

There are very few parks near Eaglewood. The city of North Salt Lake has only 4 parks besides the golf course. This has both positive and negative effects on the course. On the positive side, fewer parks means Eaglewood has played host to a yearly car show and Independence Day fireworks show bringing thousands of people to the course each year. The negatives are that there are less recreational opportunities exist for residents near Eaglewood who don't golf.

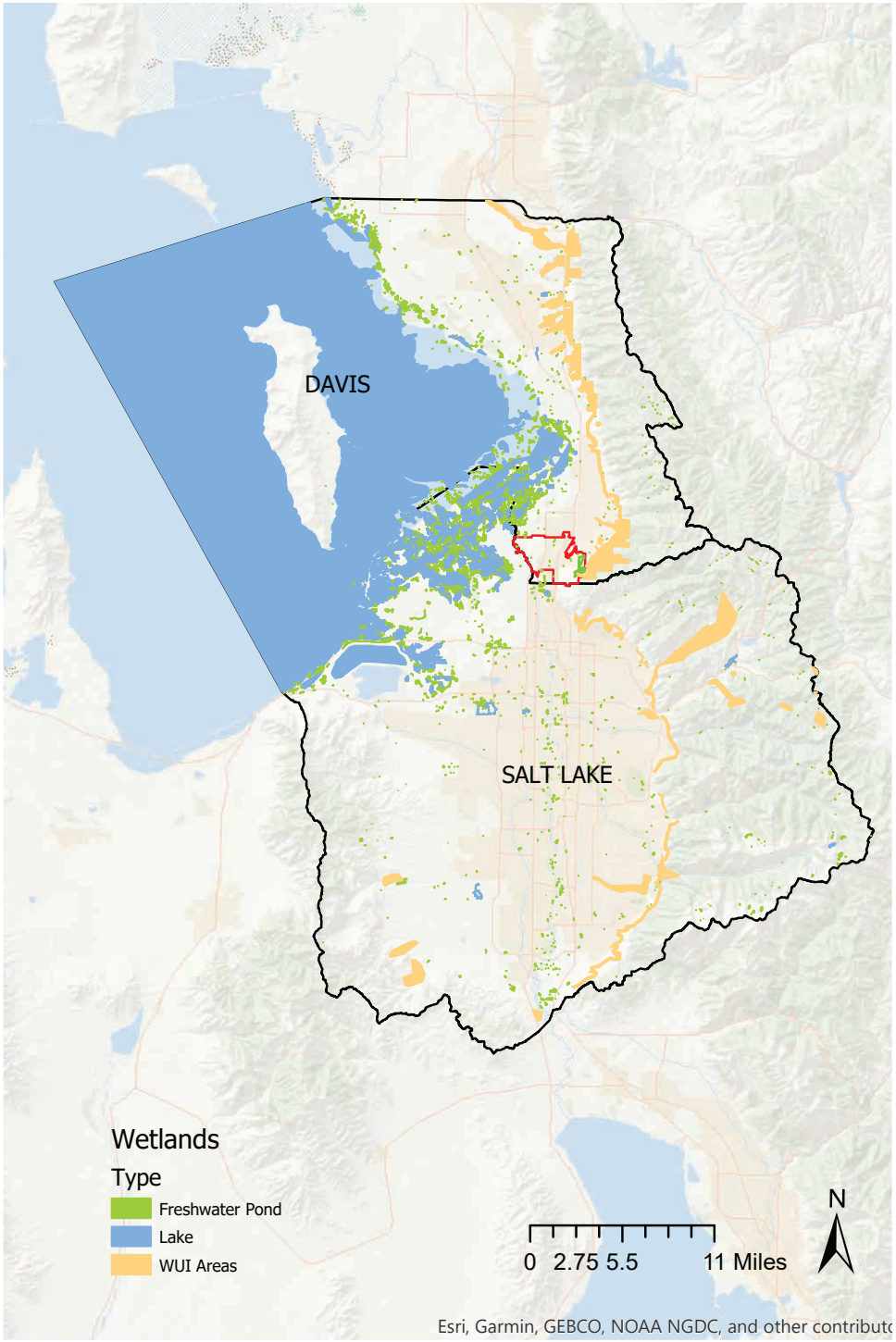


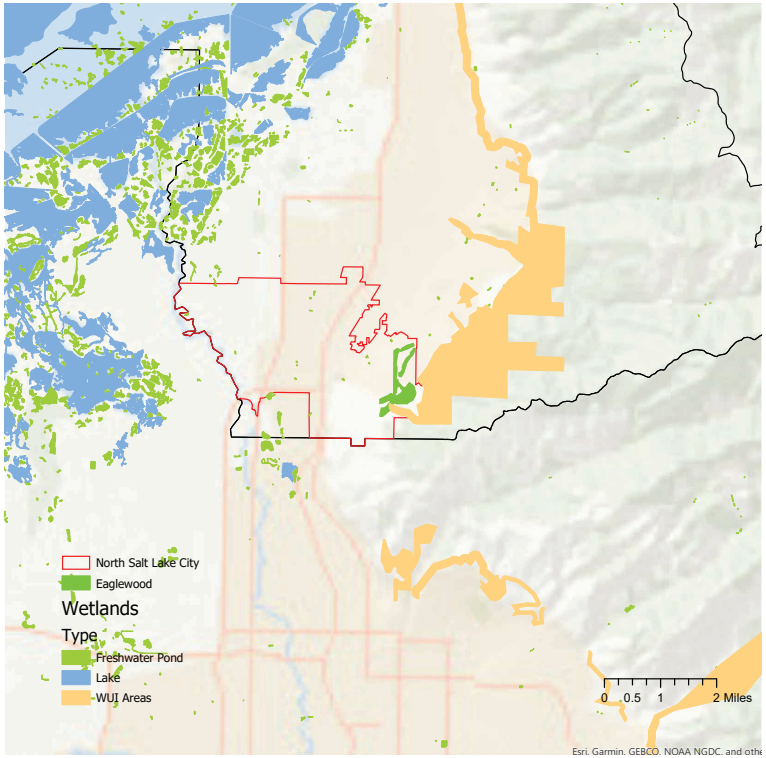


Land Ownership

Salt Lake and Davis county are almost entirely privately owned, with the exception of the Wasatch mountains to the East, which are primarily owned by the United States Forest Service, and the Great Salt Lake, which is owned by the Department of National Resources.

North Salt Lake is also almost entirely privately owned, with the exception of the Southeast corner which is overlapped by some Forest Service land. This land butts up directly against the edge of Eaglewood and creates a potential connection between the two different land uses.



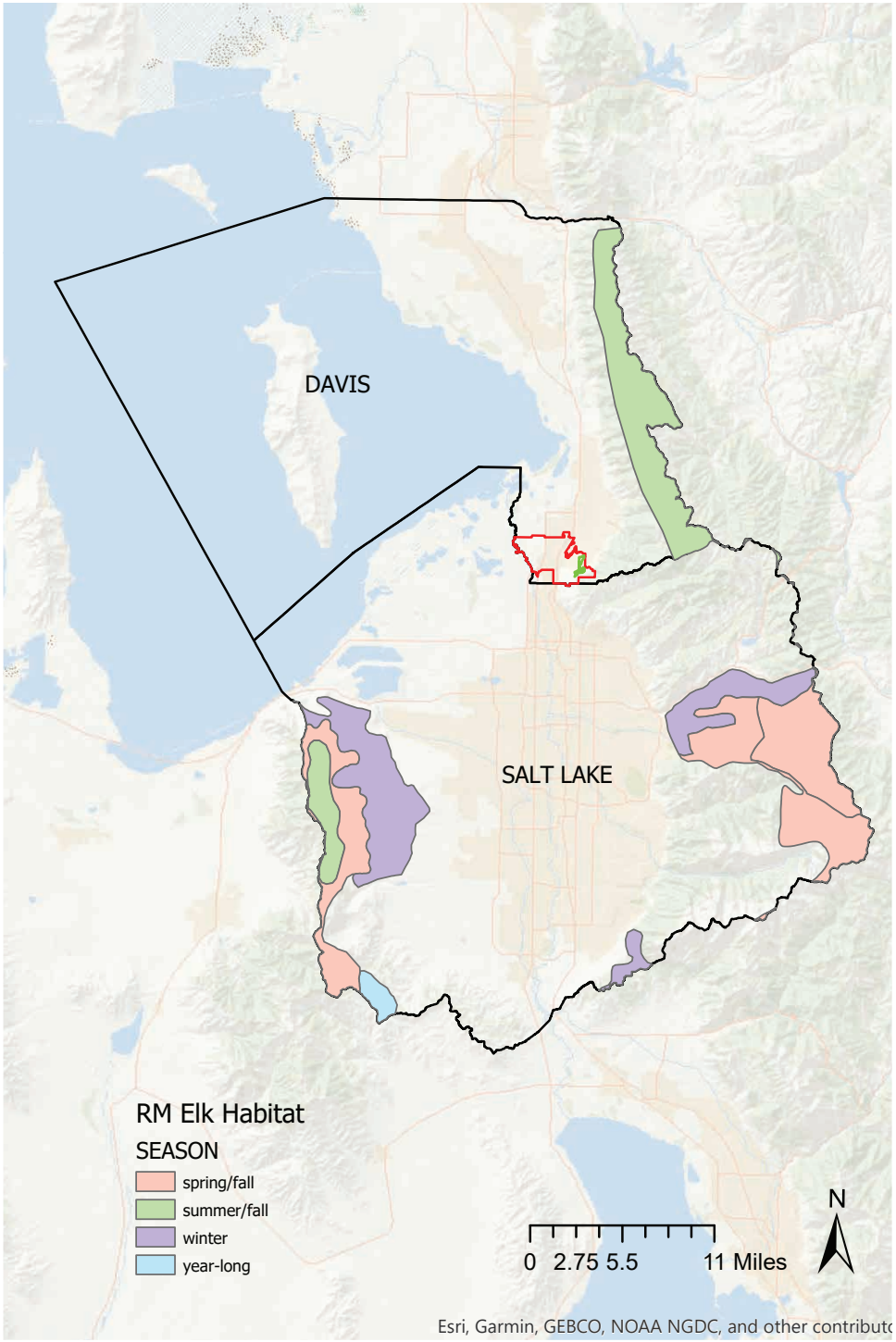


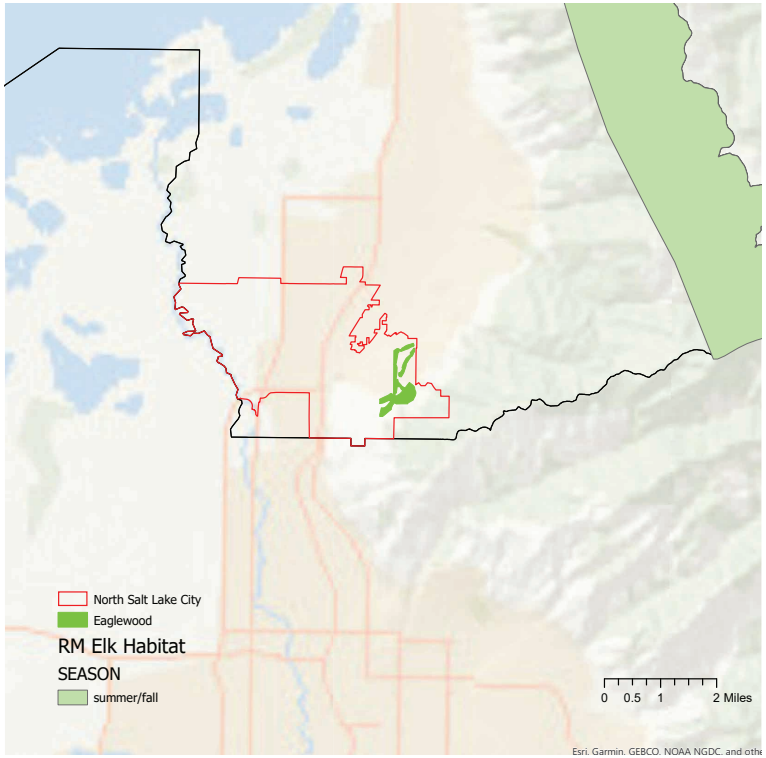
Wild-Urban Interface & Wetlands

The Great Salt Lake (GSL) and its surrounding wetland networks comprise the majority of Davis County. Salt Lake County includes part of the GSL and a large network of smaller freshwater ponds throughout the county's center.

Wildlife-Urban Areas run primarily along the edge of the Wasatch mountains on the east side of each county. There are no major lakes or parks near Eaglewood that could be used to collect stormwater.

The Wildlife-Urban Interface of the Wasatch mountains connects with the southern edge of Eaglewood. This is the most direct connection between potential wildlife habitat and the course as it currently exists.

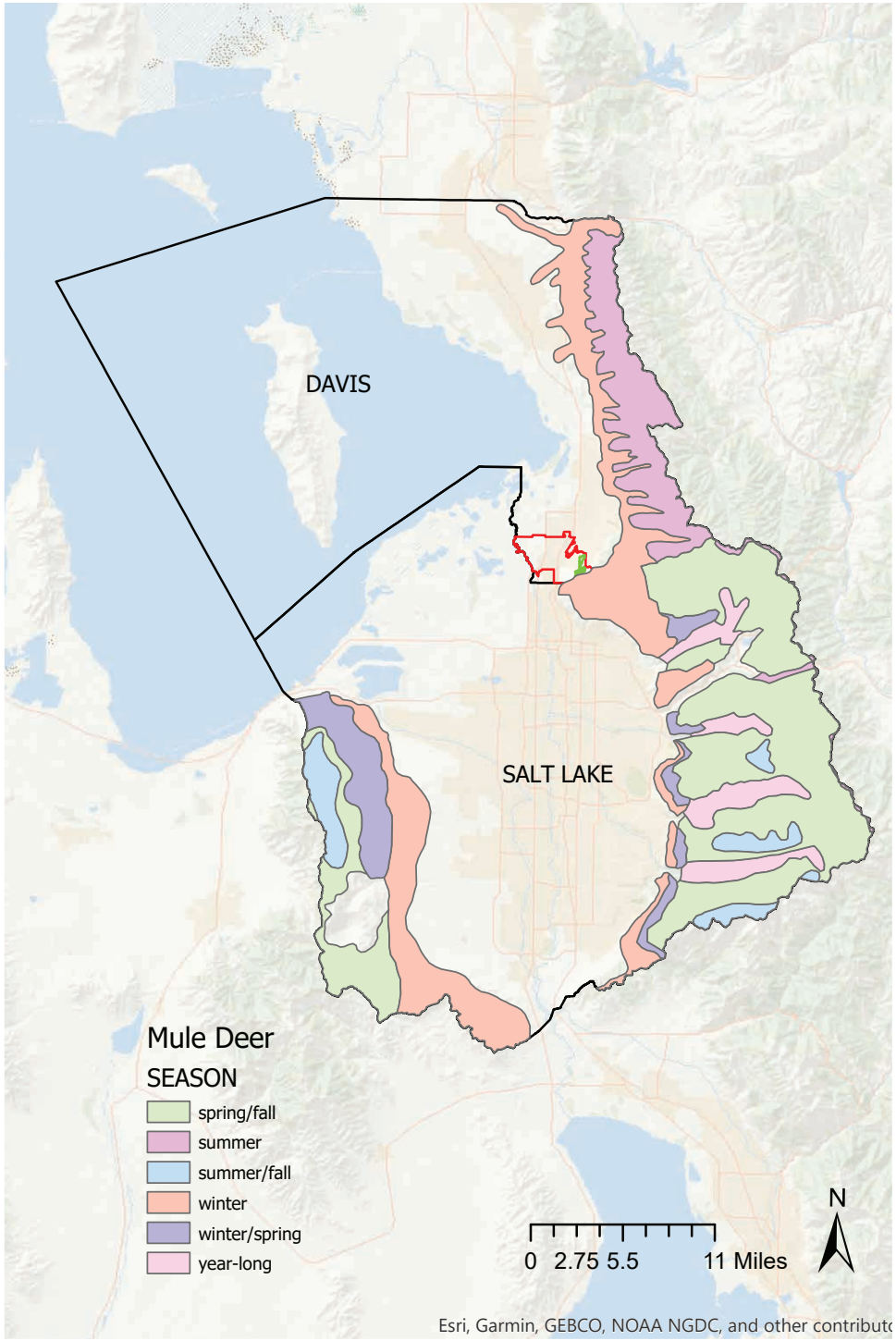


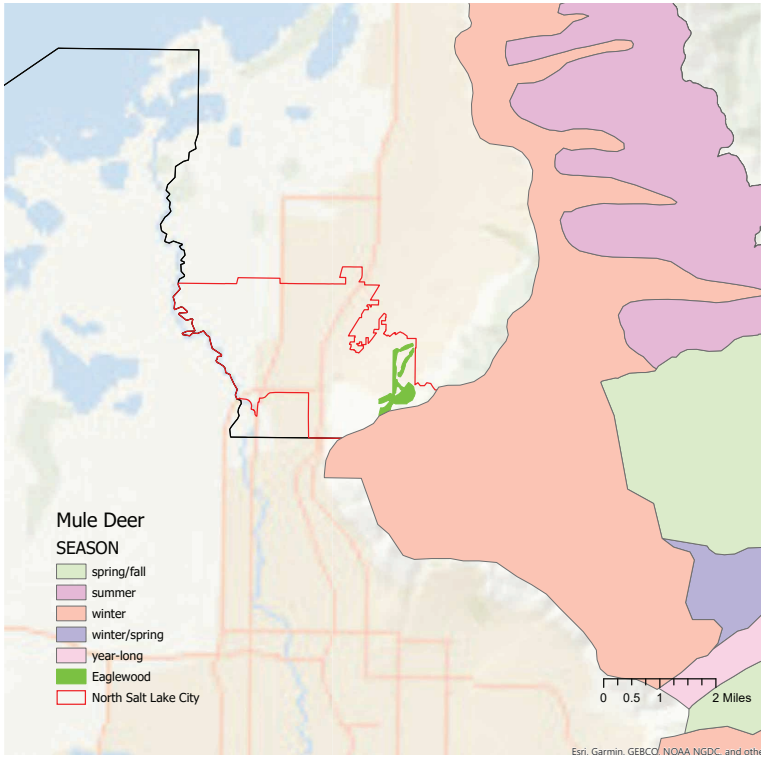


Rocky Mountain Elk Habitat

Salt Lake County has a good seasonal mix of habitats for Rocky Mountain Elk. The east and west sides of the county include suitable habitat during winter spring and fall. Davis County includes habitat along its eastern edge that is suitable for the summer and fall.

Currently, elk habitat doesn't approach Eaglewoods boundaries, but in the past elk have inhabited the course at different times of the year. There is potential to create a stronger connection between the course and the habitat of the elk, however, these large animals can damage aspects of the golf course and should not be encouraged to live on any parts of the property.

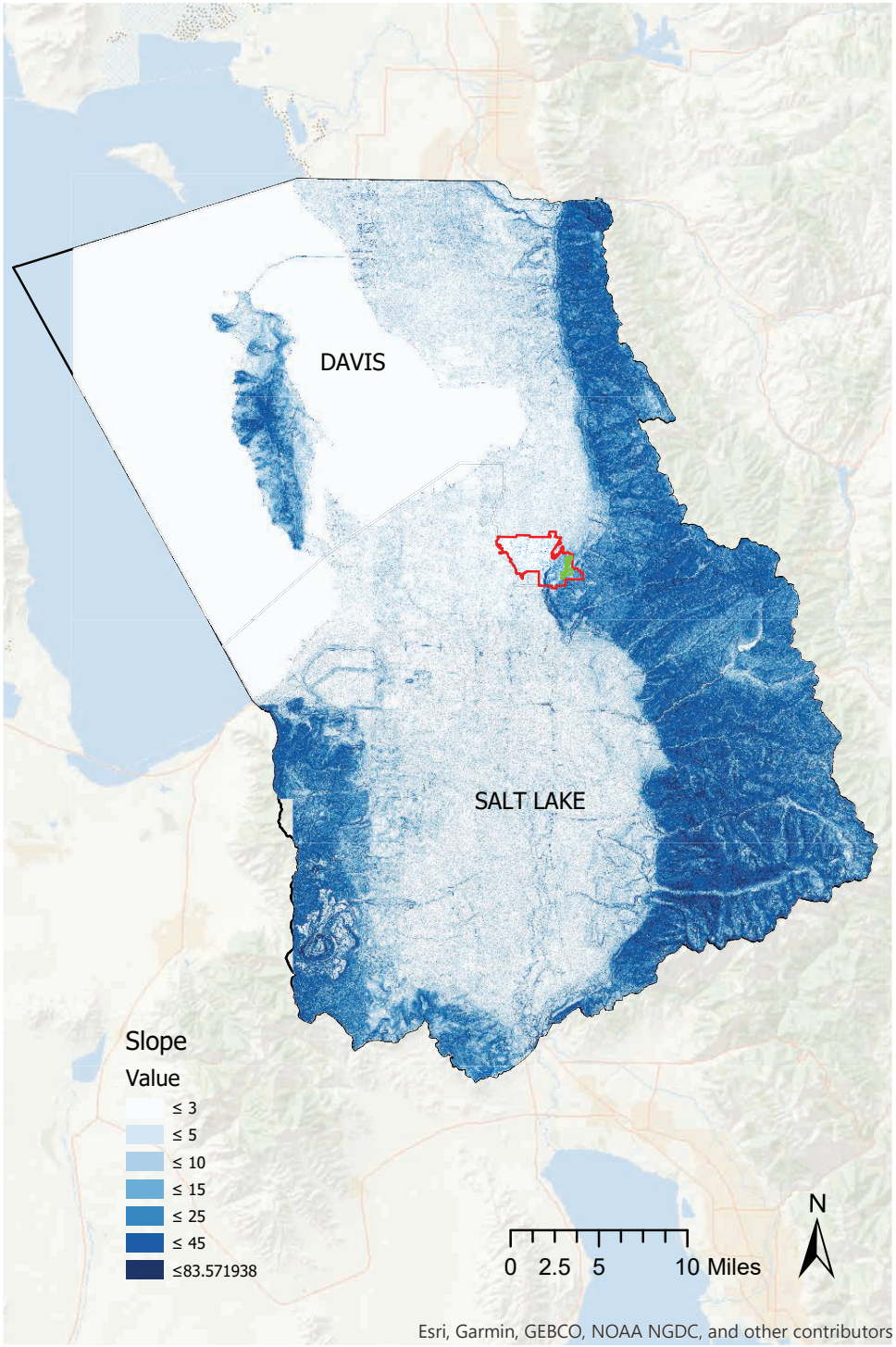


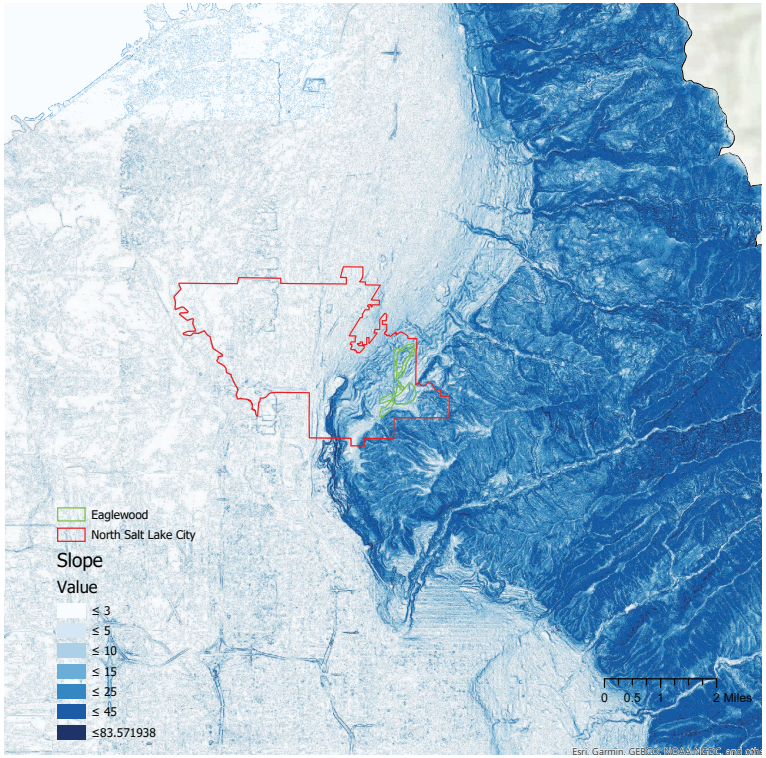


Mule Deer Habitat

Mule Deer habitat can be found in similar areas as the elk habitat but it is more suitable for year-round inhabitation. The east edges of both counties, where the Wasatch mountains stand, seem especially suitable for deer habitat.

The connection between Eaglewood and Mule Deer habitat has already been established for the winter months and the animals frequently visit the property for a variety of reasons. Unfortunately, deer can often damage the course as well, by running across greens and leaving large gouges in the turf. For this reason, deer should not be encouraged to live on the course, but they continue to be recognized as a source of wildlife in the area.

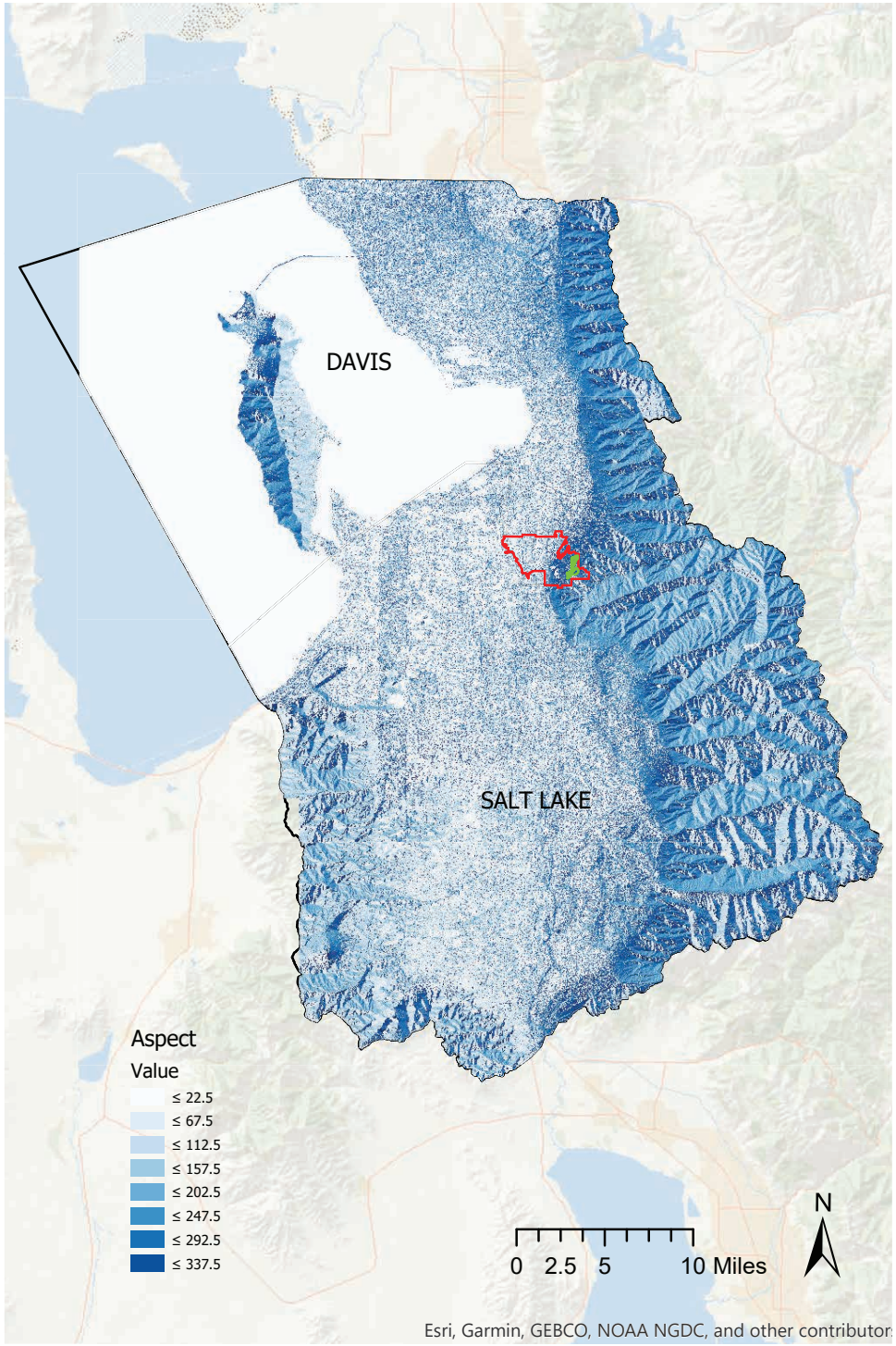


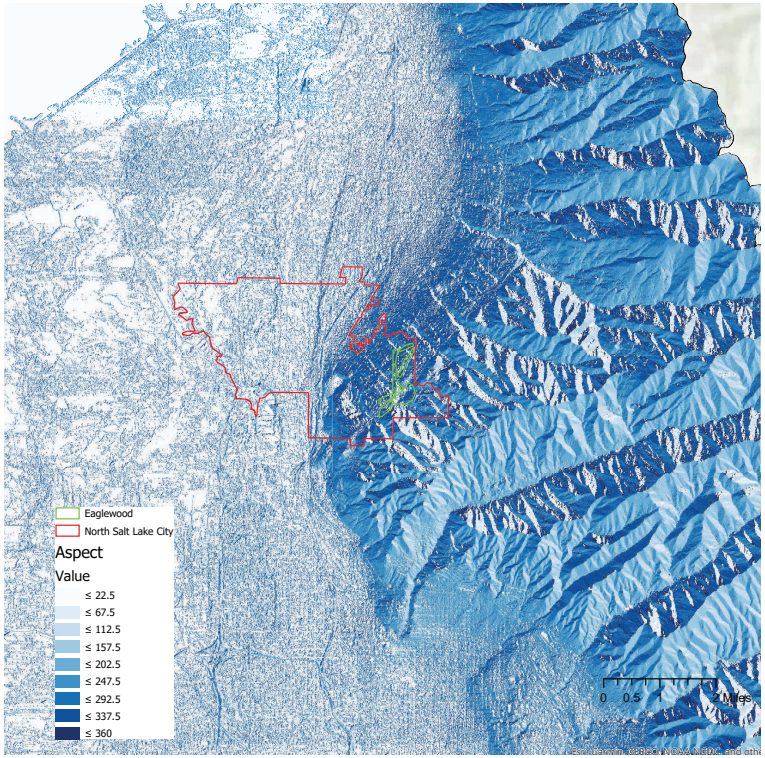


Slope

North Salt Lake City is primarily in the valley of the Wasatch mountains but the southeastern portion of the city climbs the steep slopes of the mountain to overlook the rest of the valley.

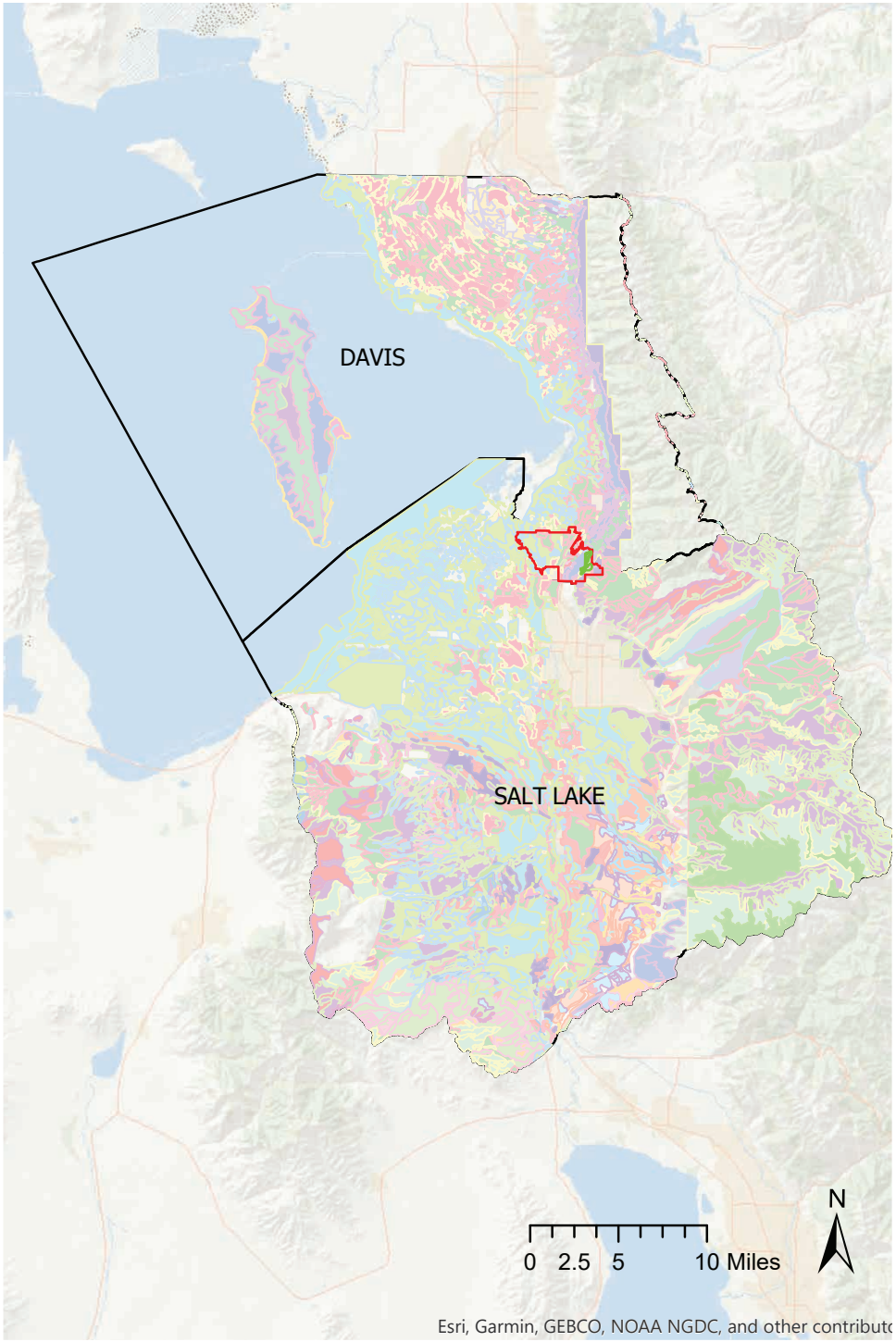
Eaglewood is located on these slopes. Holes 11-18 run directly up and down the mountainside, with slopes between a 10-25% grade, which is extremely steep. This makes for beautiful views of the valley and a challenging golf experience.

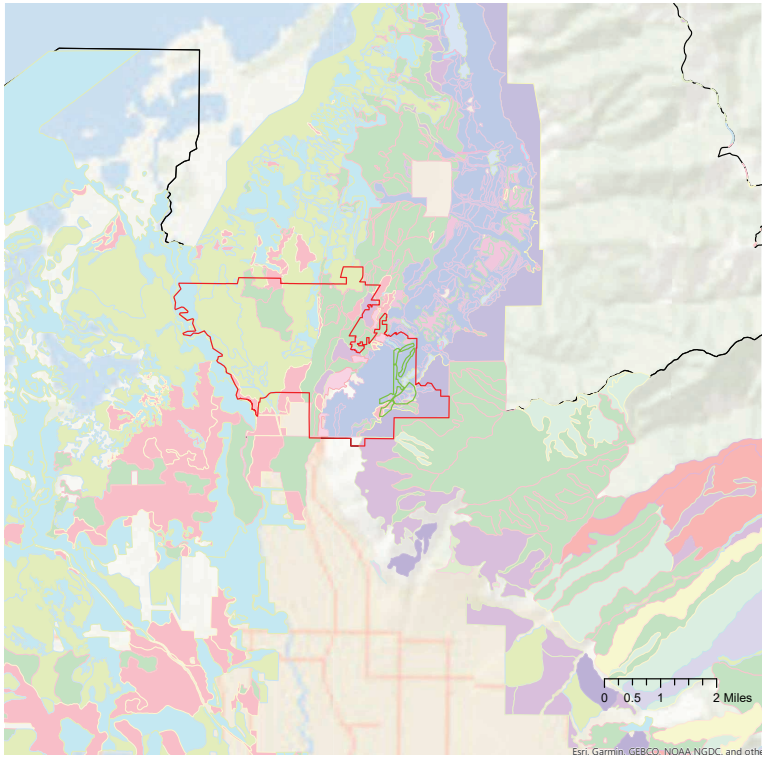




Aspect

North facing slopes are cooler than South facing slopes because of their decreased exposure to sunlight and potential to retain snowpack for longer periods of time. The majority of Eaglewood's layout is on North facing slopes and because of this, the course tends to retain snowpack and the associated spring runoff longer than most areas nearby.





Soils

Within Salt Lake and Davis county boundaries, are 36 different soil types. These maps show the wide variations in soil types that can often run right next to one another.

North Salt Lake's soil profile isn't quite as diverse, containing just 11 different soil types. The majority of these soil types consist of some combination of either cobbly or sandy loams of various different ratios.

Eaglewood is built on top of an old gravel mine so the soils vary from hole to hole and even within each hole. This creates many challenges for the maintenance staff.

GIS Takeaways

The maps shown above represent some of the key elements that can affect an environmentally resilient golf course.

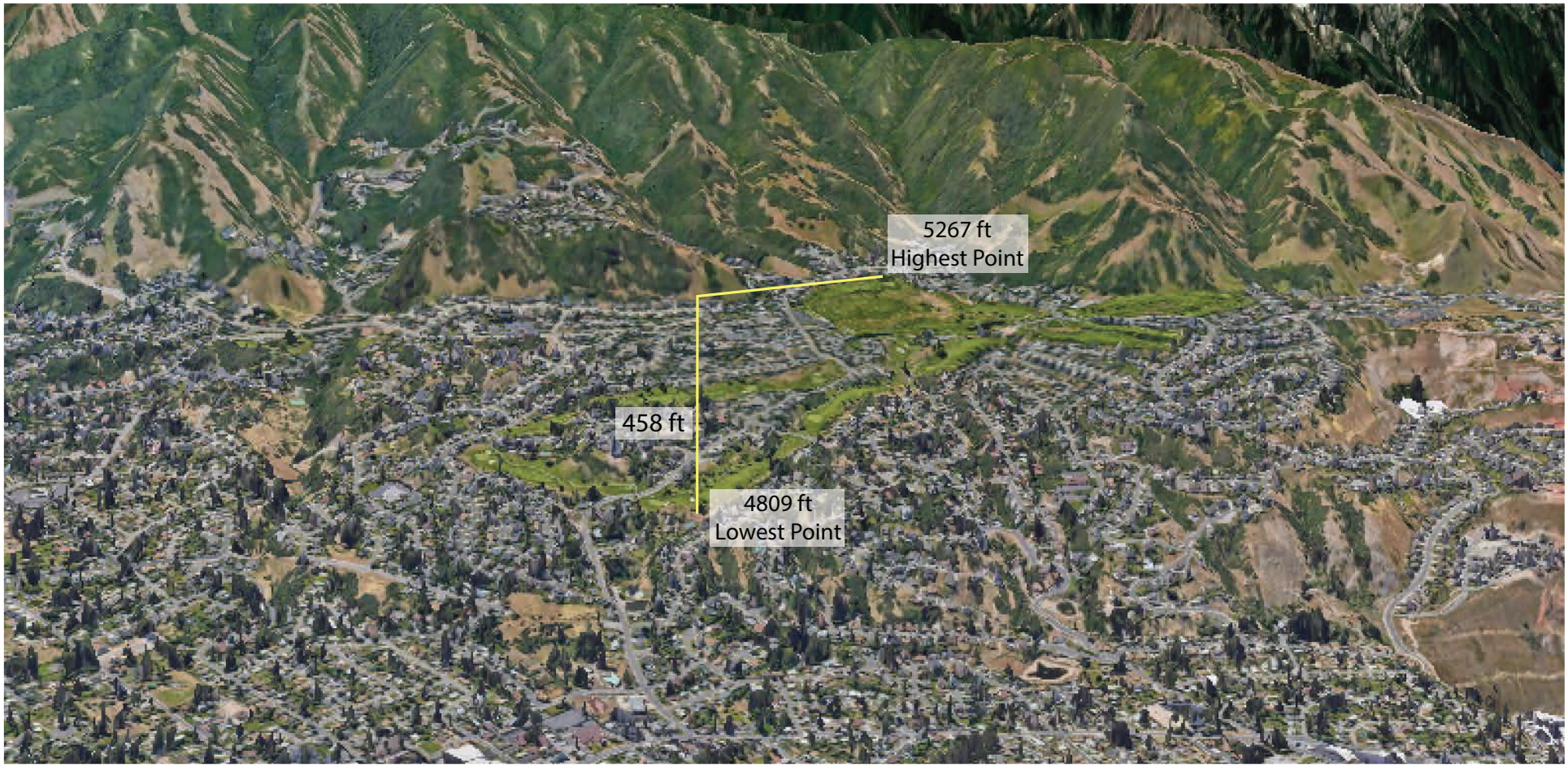
First, one must understand the context that each course fits within, that being the networks of parks and other golf courses nearby. Eaglewood has one course in close proximity, but sits above all other courses in the area, which provides players with unique views and challenges. The surrounding land use patterns can reveal current patterns of development and potential agencies that may be involved in any new developments or projects.

Since Eaglewood is situated close to a large riparian wetland, the Great Salt Lake, visualizing its association to these various water collection areas is crucial. However, the analysis reveals that the residential development surrounding Eaglewood has left little room for water retention, presenting an opportunity for the course to become an environmental amenity.

Eaglewood was built on an old gravel pit, so the soils beneath the course are complex and vary widely. The GIS analysis shows this complexity which can greatly affect the maintenance of the course.

Two of the main ungulates in the area, Mule Deer and Rocky Mountain Elk, have been seen frequently on Eaglewood over the years. While these animals are not going to be provided specific habitats on the course, they should still be recognized as wildlife that visits the course.

Slope and aspect were visualized to show the complex terrain upon which the course is built and by which it is surrounded. Eaglewood's location on the side of a mountain creates interesting and challenging golf conditions, yet it also provides opportunities and challenges for golf course sustainability. Snowmelt runoff will travel through the course each spring. If proper retention systems are present on the property, the course can take advantage of this and reduce the wasted water that enters storm drainage systems.



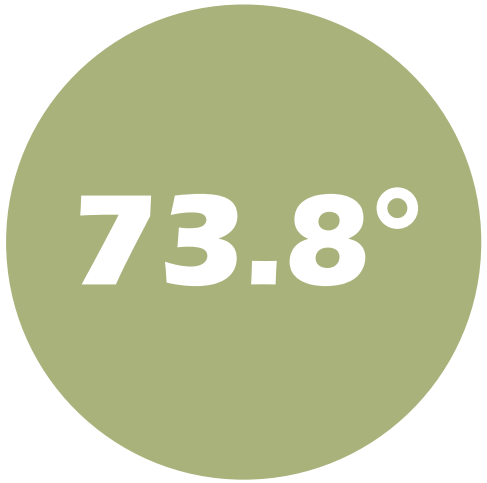
Elevation Change Visualization

Built on the slopes of the Wasatch mountains, Eaglewood is a course with severe elevation changes from hole to hole. This adds an extra level of difficulty to the course but also creates beautiful views of the valley.

Shown above are the highest point, located just above the 1st green and the lowest point, just below the 13th green. The total elevation change of 458 ft is 30 ft more than the Wells Fargo Center, which is the tallest building in Salt Lake City at 422 ft.

View of Wasatch Front and 18th hole

North Salt Lake City Climate Statistics



Mean Temperature in July
Warmest Month of Year
(°F)

Average Annual
Precipitation
(Inches)

Average Last Freeze of
Spring

Mean Temperature in
January
Coolest Month of Year
(°F)

Average Annual Snowfall
(Inches)

Average First Freeze of
Fall

Source: USU Utah Climate Center

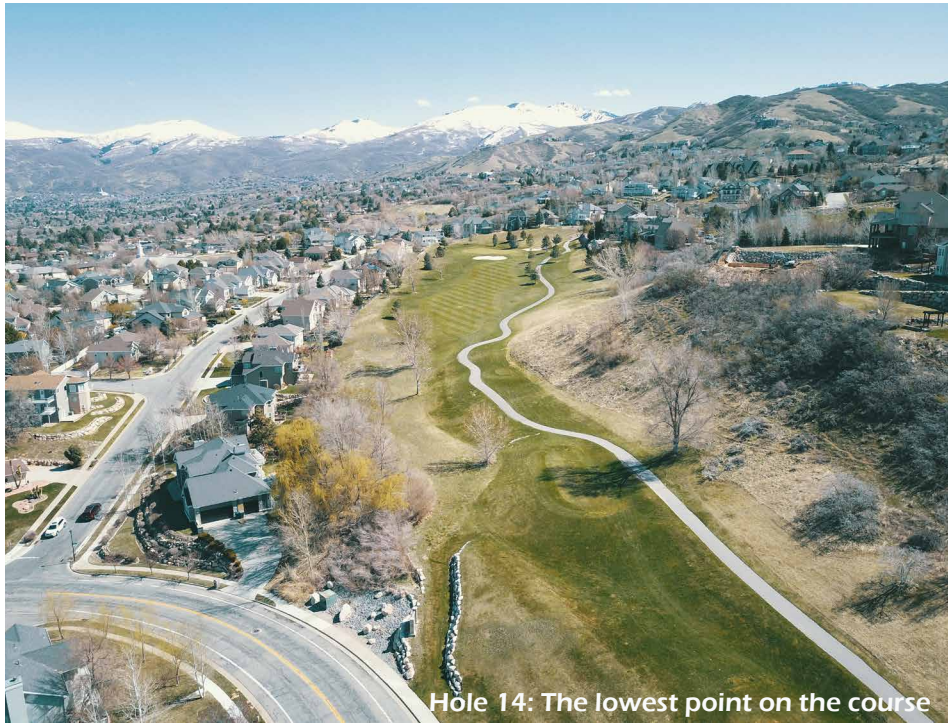
Course Photos

Looking East at the clubhouse and driving range

Holes 16 & 17: Looking South towards the basin and clubhouse

View of connection between course and mountainside

Looking East over the basin holes



Hole 14: The lowest point on the course

Wasatch front valley looking North

Site Scale Analysis Introduction

The main objective of this project is to redesign aspects of Eaglewood Golf Course to provide better on site storm water management and habitat for pollinators and birds. Accomplishing this will lead to a more environmentally resilient golf course. In order to accomplish this, the entire golf course must first be analyzed to find the areas in need of intervention.

The site analysis section focuses on the course itself and both highlights existing amenities and reveals potential areas for intervention. Some of the main focus areas include: fairways, tee boxes, areas between the fairways and tee boxes, drainage patterns and existing trees. These elements help reveal successful regions and problem areas. The course layout and routing will not be altered, meaning no greens, tee boxes or fairways will be moved. Instead, the emphasis will cemter on out-of-play areas that receive significantly less traffic.

Eaglewood is surrounded by residential housing which has led to a majority of holes becoming independent greenspaces. Landscape ecology principles claim that it is beneficial to connect greenspaces as often as possible, but since these holes are fragmented by roads and houses, such connectivity will not be possible. Rather, the goal is to provide smaller solutions for individual holes.

Fairways and Tee Boxes

Fairways and tee boxes are two of the most heavily used areas on a golf course. They are the starting point for each hole and the ideal landing area when approaching the green. Currently, Eaglewood fairways and tees consist of Kentucky bluegrass, a common cool season grass for this region.

The tee box areas and approaches to fairways are the most ideal spots for providing habitat and collecting stormwater. Typically consisting of longer grass, called rough, players aim to hit their shots over these gaps into the fairway. bBecause of this, these areas get very little traffic and can be redesigned for ecological benefits.

Trees & Water

Eaglewood has three main water bodies on the property. The two largest function as retention ponds in the basin area of the course. This area is shaped like a large bowl, wherein water funnels off the slopes of the surrounding residential neighborhoods to collect in ponds. These ponds also serve as a hazard for holes 8 & 9. The third body of water is a small creek and retention pond system located on the 16th hole that surrounds the green complex.

Eaglewood has many ornamental trees planted on each hole, which serve many roles for both the golfing and ecological communities. The trees act as barriers between holes, homes and golfers. They also provide obstacles for players to navigate.

Vegetation Types

The main two types of native vegetation found on Eaglewood are scrub oak groupings, colored in red, and native grass patches, colored in yellow. Native grass areas are great for managing water on site as they slow the flow of water and can assist in its reentry back into the ground. Native grass areas also require minimal maintenance. The most common grass type found in the native areas is Crested Wheatgrass.

Scrub oak groupings also require minimal maintenance and can create great natural barriers between holes. Scrub oak can be found all along the Wasatch mountain range and is a great indicator species for the area.

Local Road Network

Eaglewood is surrounded by residential development and many roads. The main roads that bisect the golf course are Eaglewood Drive, Eagleridge Drive, and Eaglewood Loop. They are shown above with the boldest dashing. The other roads are smaller residential access roads, most of which are not visible from the course.

These roads can also disrupt migration patterns for nearby wildlife. They are outfitted with open storm water drains. Keeping storm water out of these drains will help reduce any stresses to this existing infrastructure.

Drainage

Course drainage is one of the main factors for this project. Eaglewood takes advantage of steep slopes on just about every hole. This can allow for good drainage in some areas but can also create problems in other areas. The arrows indicate the general direction that water will flow across each hole. The light blue areas illustrate existing features on the course that adequately manage runoff. The yellow areas are the primary areas that could be improved to better collect runoff.

Existing Ecological Infrastructure Examples

Holes 6 & 7 have large groupings of native scrub oak swales that function as a barrier between each hole, blocking errant shots, noise and creating a feeling of separation. During the summer and into the fall, the dense foiliage is a beautiful aesthetic for the holes as well.

Ecologically speaking, these trees were kept on the steep slopes between the holes in order to help slow the flow of water off the fairways. The bases of these trees have been overgrown by native grasses that further help with disrupting water flows. It is especially important to keep water on-site on these holes because they are surrounded by residential homes and any rapid runoff could cause serious damage to one of the homes.

The basin holes, which consist of holes 1, 2, and 8-10, house the two large retention ponds for the course. The image to the left helps visualize the steep slope of the surrounding residential neighborhoods that border these basin holes.

Currently, the retention ponds capture large amounts of water from both the surrounding neighborhoods and the courses irrigation system. The ponds are then able to pump this water back through the irrigation system so it can be reused in times of need. Such times typically fall during the hot summer months and in early spring/late fall when the course can no longer draw water from the secondary water system.

Over time, a few problem areas have emerged in the basin, areas that are collecting water frequently during spring snowmelt and major precipitation events. They are located on hole 10, which runs along the pictured road, because that hole is the lowest point of the basin.

Hole 15 is an uphill par 3 that is very difficult because it tends to play into the wind often. The houses on this hole are generally out of reach, which is unique for Eaglewood. Another unique feature of this hole is the large swale on the right side. Eaglewood has miles of swales running along each hole but what separates this feature from the rest is the depth of the swale. The lowest point of the swale is approximately 6 feet below the nearby rough areas.

During the summer months, native grasses will reach a height of 4 to 5 feet, making this hole feel much tighter than it actually is. However, the swale is crucial to keeping water from running into the backyards of the homes downhill.

The tee boxes of the 14th hole are the lowest point of the entire property. The 14th hole begins a difficult stretch of holes heading directly back up the mountainside towards the clubhouse. The steep mountain slopes create a nearly blind tee shot for players and funnel the cart path towards the middle of the fairway.

The entire left side of the 14th is a large swale filled with native grasses. The entire hole is surrounded by residential homes and keeping water out of these properties is crucial. As the 14th is the lowest point on the course, this hole is often wet even when the rest of the course is dry. In fact, the slope to the right of the tee boxes has experienced multiple land slides during wet conditions.

Habitat Creation

Insects & Birds

Attracting pollinators is a major focus of the renovations at Eaglewood Golf Course. Pollinators serve an important role in ecosystems, as they collect and transport pollen from plant to plant, facilitating reproduction in a major portion of the plants in a community. Pollinators also support biodiversity and health within their ecosystems.

Attracting birds to Eaglewood needs to be done carefully, for certain species of birds, like geese, can leave droppings all over the course, which is not desirable. However, a healthy community of bird species serves as an environmental amenity and promotes biodiversity.

Insects are a major pollinator, specifically bees and butterflies. These insects are indicators of a healthy plant ecosystem and reduce the necessary inputs to maintain this health.

Red Butte Gardens Salt Lake City, UT

Native Plant Use

As our water resources continue to be stressed, a need for water wise plant selections will only increase. Native plants can fill this need rather well. Utah is home to many different plant types, ranging from riparian communities to alpine mountain communities.

Native plant use has increased in popularity in recent years. Native plants are well-adapted to the regions in which they are planted in and because of this, then tend to require less irrigation and maintenance. Native plants also attract local wildlife, which is an important aspect of this project.

For the purposes of this project, native plants will be heavily utilized in any vegetation coverage interventions. While there are hundreds of possible choices, a few examples of the most suitable plants are shown on the following pages. Swale areas will be planted with a combination of native perennials, shrubs and grasses.

Source: USU CWEL Fact Sheet

Native Plant Palette

Chocolate Flower

Berlandiera lyrata

Requires no supplemental irrigation. It can reseed itself and is very tolerant of poor draining clay soils.

Mountain Rush Grass

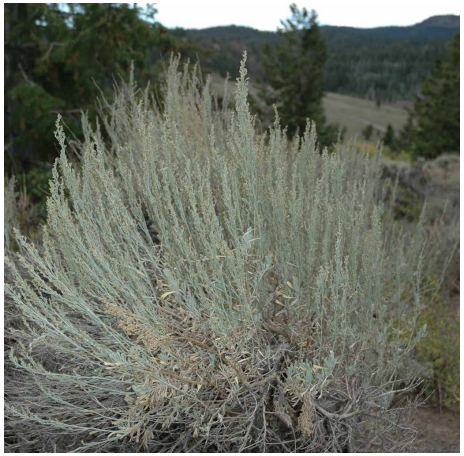
Juncus balticus

Low water requirement and is highly tolerable of standing water. Can also tolerate seasonal drought. Best used in the lower levels of a swale.

Rabbitbrush

Ericameria corymbosum

Requires no supplemental irrigation. Silver foliage with yellow flowers that bloom in late fall. Highly attractive to pollinators.



Mountain Big Sagebrush

Artemisia tridentata var. vasevana

Requires no supplemental irrigation. Highly tolerant of cold temperatures, seasonal drought and poor quality soils.

Lacy Buckwheat

Eriogonum corymbosum

Requires no supplemental irrigation. Late summer bloom with white flowers. Highly attractive to pollinators.

Winterfat

Krascheninnikovia lanata

Requires no supplemental irrigation. Flowers in mid spring. Low growing shrub. Highly attractive to pollinators.

Source: USU CWEL Fact Sheet

Native Grass Seed Mix

The native grass areas of Eaglewood consist of a combination of the six grass types shown above. Wheatgrass and fescues are very water efficient grasses that can be maintained to a short rough length (approximately 3") or allwed to grow to heights of up to 5' in order to create a hazard and barrier. These grasses require no supplemental irrigation or chemical inputs after an establishment period of a year. When the grasses aren't watered, they turn a yellow-brown color and provide a great pollinator habitat. For this project, all native areas will use the current seed mix that consists of:

Crested Wheatgrass:	24.49%
Thickspike Wheatgrass:	19.67%
Red Fescue:	14.86%
Western Wheatgrass:	14.76%
Hard Fescue:	12.96%
Sheep Fescue:	12.57%
Other Material:	0.69%

Site Analysis Takeaways

Focusing in on the course itself, there are a few main aspects of a golf course that can influence habitat creation and water retention on site. These are the existing rough areas in between and around fairways and tee boxes. Ornamental trees and water bodies were drawn to both show the existing infrastructure for the course and highlight potential areas for improvement.

Eaglewood has two major native vegetation types, scrub oak groupings and native grass areas. Both run throughout the edges of the golf course and will be used as a template for creating native habitats on the course. These renovations should reflect the existing plant communities.

The local road network creates the fragmented greenspaces that make up Eaglewood Golf Course. These roads cut between different holes and will serve as man made barriers to water retention and wildlife movement.

The drainage map illustrates the flows of water across the course and highlighted areas where the course currently collects water, both intentionally and unintentionally. Eaglewood's location on the side of a mountain leads to many design challenges, and over time, the stormwater infrastructure has begun to decline in some areas and has been neglected in others. Areas that unintentionally collect water are prime candidates for interventions.

Existing ecological features of the course will be used as a template for the suggested renovations. This will ensure consistent function and aesthetic for all features of the course. There are multiple points throughout the course that can use improvements in order to improve the ecological function of the property.

Looking west towards the Oquirrh Mountains

Retention pond near 10 tees and 9th green


DESIGN RENOVATIONS

Introduction to Design Renovations

Eaglewood Golf Course has many interesting ecological features throughout the course. However, the site analysis revealed that improvements can be made in multiple areas in order to increase wildlife habitat provisions and on-site storm water management. These are the intended outcomes of the design renovations. The three main questions that need to be addressed upfront are:

Which areas of the course will be renovated?

The main focus of renovations at Eaglewood will be in out-of-play areas, because they receive the least amount of daily traffic and play. These include, tee boxes and surrounds, irrigated turf on roadsides and gaps between tees and fairways. Other areas are included on a case-by-case basis.

What types of habitat will be created?

The main focus of habitat creation at Eaglewood will be creating environments where smaller insects and animals, such as pollinators and birds, can thrive. Due to their small size, such creatures can survive in smaller habitat areas, which makes creating these habitats much easier in limited space. Pollinators are typically drawn to the native plants of Utah, so any interventions will incorporate these plantings. Many types of birds are attracted to the ornamental trees and riparian areas that a golf course can provide.

How will storm water be managed on-site?

Managing storm water on a site like Eaglewood can be very difficult. The steep slopes upon which the course was built can lead to quick runoff of water during precipitation events and therefore must be managed carefully. In keeping with the existing storm water infrastructure, a series of swales will be created to collect and filter the water that runs across the course, keeping it out of the surrounding residential homes and on the course, where it can be drained and reused in times of need.

Renovation Areas

Issue

The area between the 3rd green and the tee boxes for the 4th hole has been identified as an area with high potential for both storm water management and habitat creation. Currently, this area is managed as a large rough grass area that is mowed, fertilized and treated like any other rough area of the course. Due to its location between a green and tee boxes, this section of the course is only in play for extremely errant shots. Located in a small depression, this area is often a collection spot for water even in dry conditions.

Proposed Solution

Given the current conditions, creating a large patch of native grass would not only help improve the water collection in this collection area, but could also provide both pollinator and bird habitat. With the exception of the existing tee boxes, replanting the area with native grasses and regrading the slopes to create a more effective collection area in the center would improve this often overlooked section of the course. All other tee boxes could be renovated in a similar fashion.

Renovation Areas

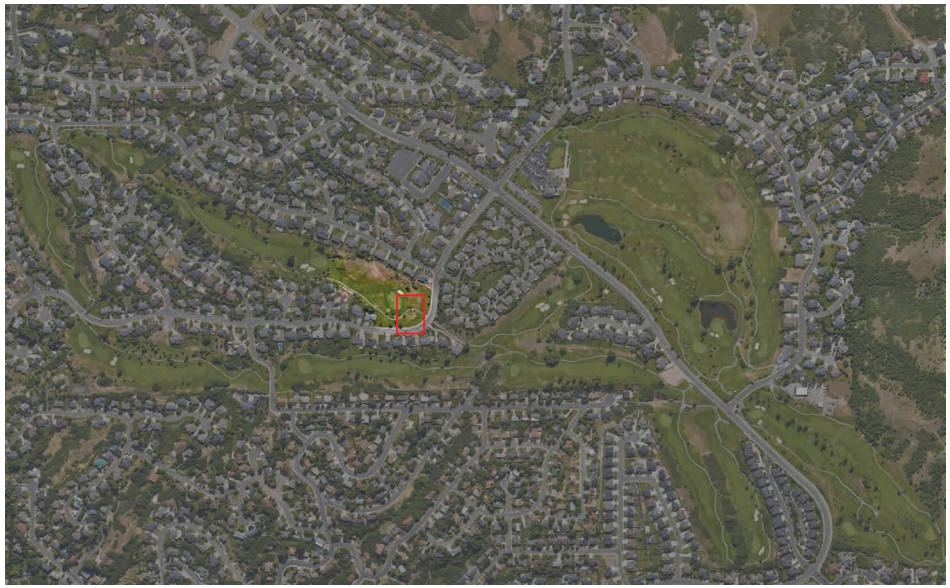
Issue

Located behind the 12th green, this very steep slope is covered in turfgrass managed like rough. There is a drain inlet near the bottom of the hill, but the water often runs so quickly down to the inlet that it becomes overflowed and runs into the road below.

Proposed Solution

In order to both slow the rate of water flowing down the hillside and create a more aesthetically pleasing look from the road, I recommend extending the native grasses that currently exist above this slope and run along the edge of the hole. This will create a consistent look for the entire hole and require less maintenance than is currently required to mow and water an area that is almost entirely out of play.

Renovation Areas



Issue

The large turfgrass area beyond and above the 17th green is out of play for golfers and provides no service for the players or residents. The turf is managed to the same standards as any other rough area, requiring frequent irrigation and chemical application to preserve its look. It is located on a very steep side slope, from right to left, and often gets overrun with water during snowmelt or heavy rains. The house pictured has been flooded multiple times due to the frequent rapid water that runs into its backyard and foundation.

Proposed Solution

For such an area, especially as it is, completely out of play, I propose the removal of all turf below and to the left of the cart path. This area could then be replanted with native vegetation. This intervention will require irrigation for the first year of establishment, but after this period the irrigation could either be shut off or removed to preserve water and maintenance time. This vegetation would help to slow the water that flows to the house and could create a better aesthetic for the residents.

Renovation Areas


10th Hole looking East

Issue

The 10th hole is located at the bottom of the large basin and along the major access road for the clubhouse. There are multiple problem areas on this hole. First, the area behind the green contains a drain inlet covered with turfgrass managed as rough and during heavy rains or snowmelt, it becomes a dirty looking pond. In the middle of the fairway, the lowest point on the hole, water collects and forms a large pond that covers the entire fairway, from the pond to the cart path. In between the tee boxes and the beginning of the fairway is another area that is closed to traffic most of the year because it is frequently under water. Water frequently runs off into the roadway as well, but would be better kept beside the road.

Proposed Solution

Creating natural swalesand riparian areas to house and collect this water will provide both a better storm water management system and an ecologically aesthetic habitat for wildlife. Overall, the current drainage system functions well but when it is overrun, it becomes a major eye sore for the hole.

10th Hole Renovation Plan

The addition of a wetland shelf provides a new habitat for aquatic vegetation and amphibians in the pond. Native grasses are planted on the banks of the pond near the 10th tees for stabilization.

The roadway is now lined with a native mix of grasses, mainly crested wheatgrass. This provides a barrier between the golfer and the road, collecting errant shots, and slowing down the water from entering the roads drains.

This proposed swale network will create a new method for water collection and provide pollinator habitat. Running almost the entire length between the retention ponds, the entire basin can now collect water without runoff into the road.

A large gathering basin behind the 10th green is currently managed as rough grass. It has an existing drain inlet. Planting with native vegetation will save water and provide habitat for pollinators.

10th Hole Swale and Replanting


Existing fairway and tee boxes of 10th hole

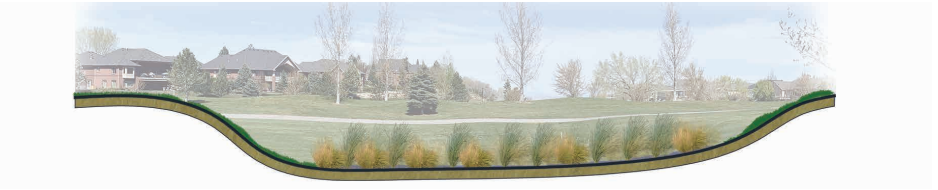

Visualization

The most crucial renovation for this entire project is the proposed swale and replanting at the 10th hole. This renovation solves a few current issues for the maintenance staff at Eaglewood:

- The individual fairway bunker on the right of the image has been washed out over the years and is now overgrown with weeds.
- The area between the beginning of the fairway and the end of the tee boxes is overrun with water each spring, creating a large pond of unmanaged water.

Removing the washed out bunker will reduce maintenance time and make the hole more playable, as it will widen the landing area for tee shots. The swale network will create an ecological solution for the frequent collection areas. During dryer periods, the swale areas will serve as a hazard during dryer periods, adding an additional challenge for the players. The large collection areas will provide a large habitat for native plants and wildlife, nearly connecting the two large existing retention ponds.

Section: Tee-Fairway Collection Area



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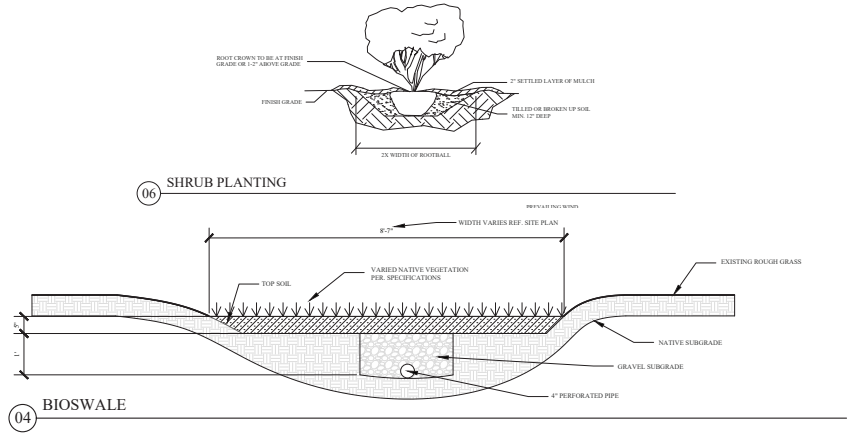


10th Hole Fairway Swale

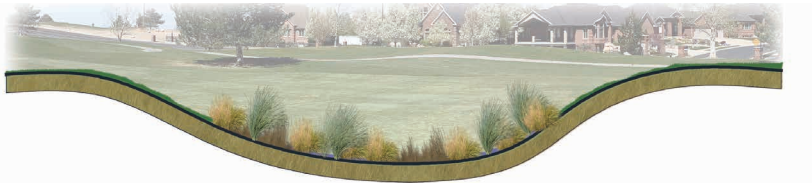

Existing fairway and tee boxes of 10th hole


Visualization

Another critical renovation is the proposed fairway swale on the 10th hole. This solves a recurring issue with which the Eaglewood maintenance staff deals. Approximately 100 yards out of the green, exists a depression in the fairway that collects water frequently. This depression damages the fairway in that area and has now overloaded the existing drainage system.

The proposed swale will create an additional hazard for golfers and is the only proposed renovation that will affect a playable area of the golf course. A drive of over 300 yards is required to reach this swale, meaning it is out of play for the majority of golfers tee shots. The main purpose of the swale is to collect water during large precipitation events and reduce the demands on the existing drainage system.

Section: Fairway Swale



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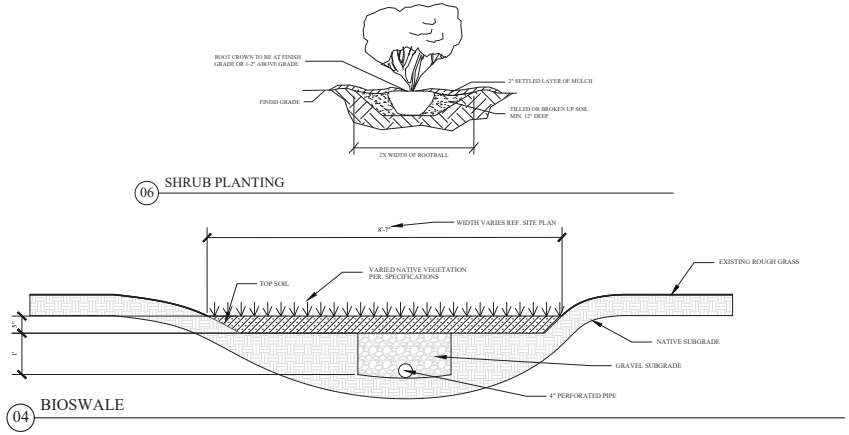


Retention Area behind 10th Green

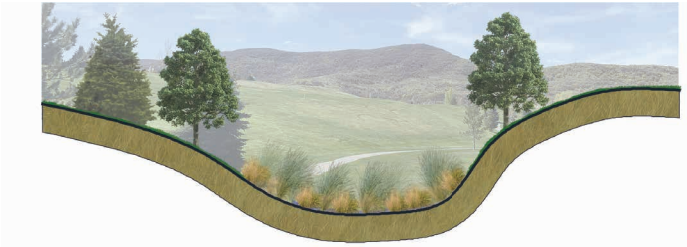
Existing depression behind 10th green

Visualization

The existing depression behind the 10th green includes a drain inlet that collects water during precipitation events. However, it has very little ecological function outside of these times. It is out of play for almost all golfers because the 10th hole is a long uphill par 4 that typically plays into the wind, making going over the green on a second shot difficult.

The proposed renovation would require minimal disruption to the existing land. Removing the turf and replanting the area with a blend of native shrubs and grasses will create a better functioning water retention area. It will require no irrigation and little maintenance, saving the staff time and money each year.

Section: Swale Behind Green



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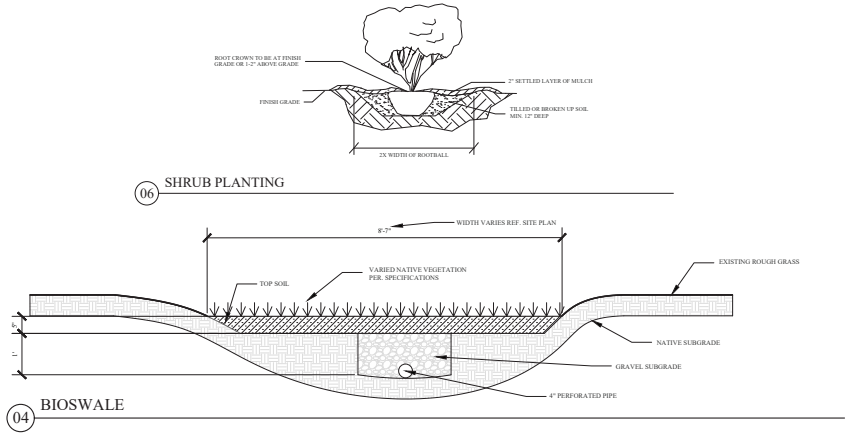
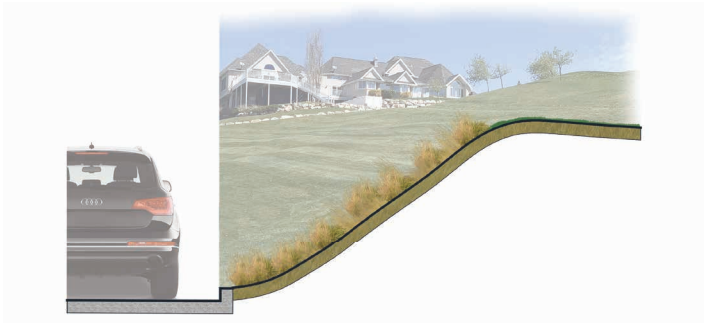


10th Hole Roadside Replanting

The 10th hole at Eaglewood runs along Eagleridge Drive, the main access road for the course and surrounding neighborhoods. The edge of the course is crowned, with a steep grass slope running towards the road. This area is heavily irrigated and all the water runs off into the road, creating a consistent flow of irrigated water into the storm water drainage system. This flow needs to be slowed in a visually appealing way, as so many people travel along this route each day.

Replanting the roadside with native grasses and shrubs will create a barrier between the golf course and the road, both visually and physically. The native plants are consistently used as vegetated barriers throughout the course. They are aesthetically pleasing, require no irrigation and minimal yearly maintenance and can block errant shots from reaching the road.

Section: Roadside Replanting



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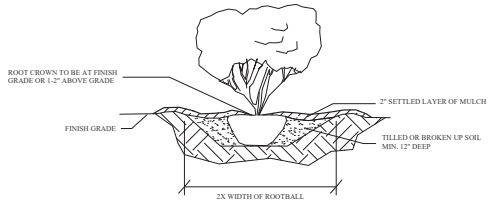


06 SHRUB PLANTING

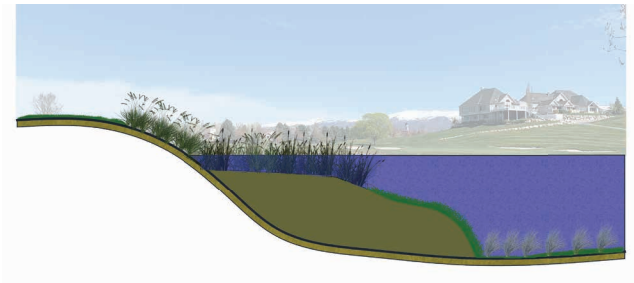
Wetland Shelf

Installation of a wetland shelf at the north end of the retention pond that runs along the 9th green and 10th tee boxes will provide another ecological benefit for the course. Wetland shelves promote aquatic vegetation growth by reducing the slope of the banks and flattening an area approximately 8"-12" below the surface of the water to support these aquatic plants.

After aquatic plants arrive, aquatic animals like fish, frogs and other amphibians can thrive in their new environment. By locating this shelf along the bank of the 10th tee boxes, there should be minimal golf balls and human traffic in this sensitive area.

The vegetation that grows in these wetland areas can also help filter water pollutants before they enter the groundwater or man-made infrastructure.

Section: Wetland Shelf



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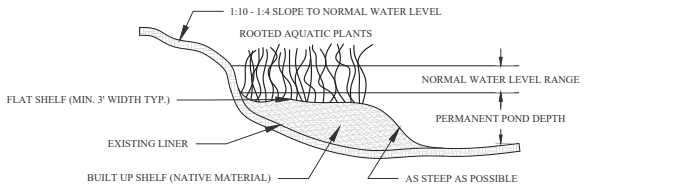


Renovation Takeaways

The proposed renovations are a variety of examples of the types of interventions that could benefit Eaglewood Golf Course. Beginning with varying out-of-play areas, various issues and solutions were explored. The 10th hole was then explored in greater depth with the incorporation of perspective visualizations, sections, and example construction details. By implementing these types of solutions to existing problems, Eaglewood would be able to reap significant benefits, including:

- Improved stormwater management
- Reduced irrigated turf coverages
- Increased pollinator habitats
- Overall savings in maintenance costs and requirements

In addition to the renovations highlighted specifically in this section, Eaglewood could also convert many other areas from irrigated turf to native grasses, including tee boxes and surrounds, out-of-play areas and irrigated roadside turf. The more aggressive the approach taken by the course, the more ecological benefits and economic savings will be realized in the long term.


16th hole looking North


11th hole looking towards the valley

Turf Reduction Outcomes

Reducing the total irrigated turf coverage at Eaglewood is the best way to reduce water usage and save the course money. The property of Eaglewood Golf Course is incredibly large and spread out, covering almost 147 acres. Of the 147 acres, nearly 88 consist of irrigated turfgrass. Such a large greenspace provides plenty of potential for reduction in order to save money and water for the city and management staff. In the southwestern United States, where water resources are extremely stressed, regulations regarding the number of irrigated acres a golf course can maintain play a major role in the design and management of these properties. While this may not yet be a requirement in northern Utah, the time for such restrictions may not be far off. Golf courses need to begin planning for a day when irrigation allotments may be reduced.

According to a figure obtained from OB Sports, the average cost of irrigating one acre of turfgrass per year is $11,000. This project reduces the irrigated turf by just under 23 acres, or 26% of Eaglewood's total irrigated turf. As a result, the proposed renovations could result in an expected savings of over $250,000 per year on water alone with even further possible savings due to less fuel use, less machine time to mow grass areas, and fewer man hours spent mowing that could either be saved or repurposed for more detailed tasks. This may, in fact, be the difference between a golf course turning a profit or operating at a deficit.

Turf Reduction Outcomes

Size of Eaglewood Property (Acres)

Irrigated Acres of Turf

Cost of Irrigating One Acre of Turf per Year

Turf Reduction for Entire Property (Acres)

Percentage of Irrigated Turf to be Removed

Estimated Yearly Savings on Irrigation

10 Year Projection

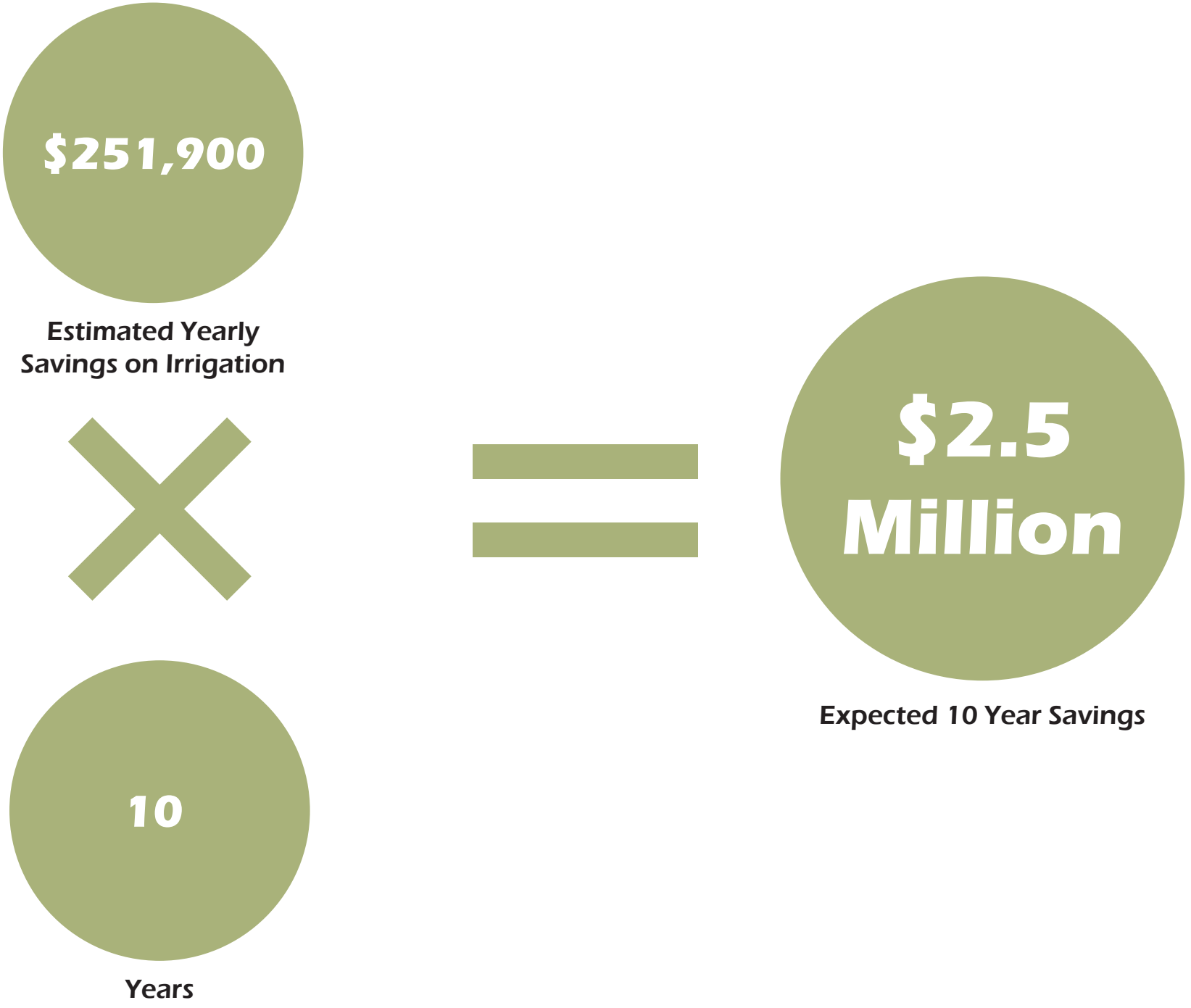
Using an aggressive approach to removing irrigated turf and replacing it with a native grass mix that requires no irrigation, approximately 23 acres of turf were removed from Eaglewood. The three main golf course features that were targeted were:

- Conversion of all tee boxes to native grass mix
- Conversion of all tee surrounds to native grass mix
- Conversion of all Irrigated out-of-play areas to native grass mix

These areas were selected because they are mostly out of play, meaning they receive little traffic and play, and can be converted without major disruptions to players.

Saving over $250,000 a year would be a massive help to operations at Eaglewood. Publicly owned golf courses typically operate close to the margins, and an opportunity to save over $2 million over the next 10 years could boost the economic and environmental resiliency of the course. This could be the difference between survival and closure for many publicly owned courses.

10 Year Projection



Basin holes & clubhouse

Conclusion

Eaglewood Golf Course is a unique place nestled on the slopes of the Wasatch Mountain Range, providing players with many unique challenges and views. The course itself includes a good amount of existing ecological infrastructure but like any 20+ year old course, it has changed over the years and is in need of some necessary improvements.

This project is meant to serve as an example of the renovations that could be made at this property to enhance its ecological function and long-term environmental resilience while still providing an enjoyable playing experience for all levels of golfers. By removing irrigated turf and replacing it with native grasses, this project can be used to save Eaglewood $2.5 million over a 10 year period. In addition to financial savings, pollinator habitat was increased throughout the course and on-site storm water management has been improved to better collect and reuse runoff.

This was accomplished by first setting Eaglewood into the larger context of the game of golf and its surrounding geographical information. After examining the property more closely, existing amenities and problem areas were highlighted. Through the use of golf course and landscape ecological design principles, solutions were created that would reduce maintenance costs, preserve and increase pollinator habitat and improve on-site storm water collection for the course.

Many other golf courses similar to Eaglewood are experiencing similar pressures and threats to their long-term sustainability, both economic and environmental. Innovative thinking will be required to solve these problems so that the game of golf, and its local municipal courses, can survive long-term.

Projecting Forward

After the gold rush of golf course construction in the early 2000's, many of the greatest sites for golf in the United States have already been developed. As we look forward to the next 20-30 years of golf course design, architects will need to be adaptable and creative while working with less-than-ideal properties. While there will always be destination sites coming available, these opportunities will be fewer and farther between. An architects ability to work within the ecological constraints of a less-than-ideal site and still provide quality playing opportunities will be critical for the future of golf.

One gap in current golf course design and renovation is an emphasis on urban golf courses. Typically owned by municipalities, urban courses like Eaglewood often provide affordable playing opportunities for people who can't afford membership to a club. Golf course architects have a real opportunity to find affordable methods for updating many of these courses. Dealing with various levels of government can complicate a project, but we cannot afford to lose these smaller, municipal golf courses due to prolonged decay.

I envision a future where golf course architects fuse naturalistic design principles with urban settings in order to create courses that can be maintained affordably and accessed by the majority of urbandwellers. While this won't be an easy task, therein lies a real opportunity to make a name for oneself by capitalizing on this untapped portion of the golf industry.

Golf and the COVID-19 Pandemic

Near the completion of this project, the world as we knew it changed due to the COVID-19 pandemic. The need for social distancing and quarantining to protect ourselves from one another caused global disruption to business, travel and recreation. Many methods of recreation, such as playgrounds, basketball courts and any gatherings of large groups of people, have been shutdown due to the close contact and commonly touched surfaces that can house the virus. Businesses everywhere are struggling through an economic crisis similar to the great depression in the 1930's.

One method of recreation that is suitable under these circumstances is golf. The individuality of the game and the large open spaces that it is played on make it ideal for avoiding close contact with others. In many areas, golf courses have never been busier than the last few months during the shutdown. This is driving many new people to the game of golf and propping up courses that may have otherwise been struggling.

The golf community has implemented many new rules to improve the safety of playing golf during the pandemic, including only allowing single-rider carts, banning removing the pin from the hole, spreading out tee times, and requiring payment via online portals. All of these ideas are meant to improve the safety of the game while still providing a recreational opportunity during a difficult situation.

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Image References: (in order of appearance)

All Eaglewood course photos taken by Foster Cook using Utah State University Drone

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Chocolate Flower
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Native Grass Image 2
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Appendix
Construction Documents: Cover Sheet

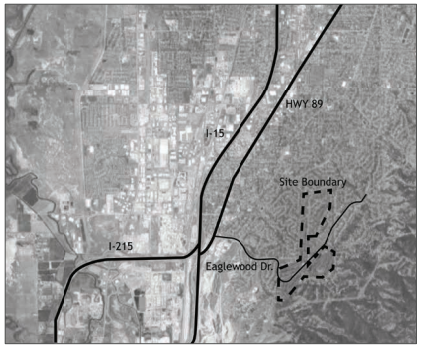
EAGLEWOOD GOLF COURSE
RENOVATIONS TO IMPROVE STORMWATER MANAGEMENT
1110 E EAGLEWOOD DR.,NORTH SALT LAKE, UT 84054

SHEET INDEX

LANDSCAPE ARCHITECT

COOK GOLF ARCHITECTS
OLD MAIN HILL
LOGAN, UT 84322
TELE: (801) 543-9922

CONTEXT MAP



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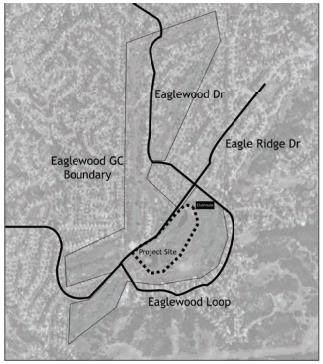
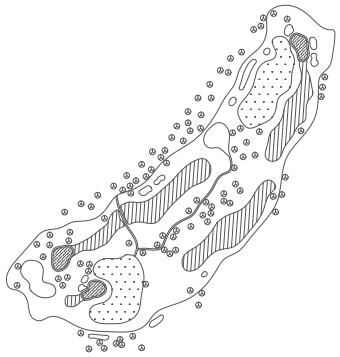


ILLUSTRATIVE MAP



GENERAL NOTES

1. THE CONTRACTOR SHALL EXAMINE THE SITE, COMPARE IT WITH THE DRAWINGS AND SPECIFICATIONS, CAREFULLY EXAMINE ALL OF THE CONTRACT DOCUMENTS, AND BE SATISFIED WITH THE CONDITIONS UNDER WHICH THE WORK IS TO BE PERFORMED BEFORE ENTERING INTO THIS CONTRACT. NO ALLOWANCE SHALL SUBSEQUENTLY BE MADE ON BEHALF OF THE CONTRACTOR ON ACCOUNT OF CONTRACTOR'S ERRORS, NEGLIGENCE, OR INADEQUATE KNOWLEDGE OF THE CONDITIONS OF THE SITE OR OF THE STREETS OR ROADS APPROACHING THE SAME.

2. CONTRACTOR SHALL FIELD VERIFY ALL JOB CONDITIONS AND DIMENSIONS. VARIATIONS THEREOF FROM THE DRAWINGS MUST BE REPORTED TO THE ARCHITECT.

3. DETAILS INDICATED ON THE DRAWINGS ARE REPRESENTATIVE AND TYPICAL. ALL ATTACHMENTS AND CONNECTIONS SHALL CONFORM TO BEST PRACTICE AND SHALL BE THE CONTRACTOR'S RESPONSIBILITY.

4. THIS DRAWING EMBODIES IDEAS, DESIGNS, ARRANGEMENTS, PLANS, AND SPECIFICATIONS WHICH ARE PROPRIETARY TO THE LANDSCAPE ARCHITECT, AND WHICH WERE DESIGNED, CREATED, EVOLVED, AND DEVELOPED FOR USE SOLELY IN CONNECTION WITH THE SPECIFIED PROJECT. NO TRANSFER OF ANY RIGHTS THERETO IS INTENDED OR EFFECTED BY DELIVERY HEREOF, AND EXCEPT UPON THE WRITTEN PERMISSION OF COOK GOLF ARCHITECTS, INC., THE DRAWING IS NOT TO BE DISCLOSED TO OTHERS, REPRODUCED OR COPIED IN WHOLE OR IN PART, OR USED IN THE FABRICATION OR CONSTRUCTION OF BUILDINGS, STRUCTURES, FOUNDATIONS, OR ANY PORTIONS THEREOF FOR OTHER THAN THE SPECIFIED PROJECT.

5. THE OWNER WILL PROVIDE BENCH MARK DATUM POINT AND HUBS INDICATED ON THIS PLAN.

6. PRIOR TO START OF WORK, VERIFY CORRELATION OF DATUM POINTS INDICATED ON THIS PLAN AND NOTIFY LANDSCAPE ARCHITECT OF ANY DISCREPANCY.

7. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL LAYOUT AND MEASUREMENTS AS NOTED IN THE SPECIFICATIONS "GENERAL REQUIREMENTS." ALL SURVEYING AND FIELD ENGINEERING NECESSARY TO ESTABLISH THE LINES AND GRADE STAKES SHALL BE PERFORMED BY A LICENSED UTAH LAND SURVEYOR OR CIVIL ENGINEER LICENSED TO PERFORM LAND SURVEYING.

8. THE LIMITS OF WORK ARE AS DELINEATED ON THIS PLAN.

9. STOCKPILING OF MATERIAL SHALL BE PERMITTED ONLY IN AREAS DELINEATED AS STOCKPILE AREAS THE PLANS.

10. THE CONTRACTOR SHALL PROVIDE AND MAINTAIN A TEMPORARY OFFICE ON THE PREMISES WHERE DIRECTED, UNTIL COMPLETION OF THE WORK.

11. THE CONTRACTOR MAY UTILIZE THE SOUTH PARKING LOT AS HIS TEMPORARY OFFICE FOR THE DURATION OF THE WORK

12. THE CONTRACTOR SHALL PROVIDE PORTABLE SANITARY FACILITIES ADEQUATE FOR ALL WORKERS. THE TYPE OF TOILETS USED AND THEIR MAINTENANCE ARE SUBJECT TO APPROVAL AND INSPECTION BY THE CITY HEALTH DEPARTMENT. HAND WASHING FACILITIES SHALL BE PROVIDED NEARBY THE TOILET FACILITIES.

13. BEFORE COMMENCING WORK UNDER THIS CONTRACT, THE CONTRACTOR SHALL CALL BLUE STAKES OF UTAH, 811.

14. POINT OF CONNECTION FOR WATER SUPPLY SHALL BE WATER METER. THE CONTRACTOR SHALL ARRANGE AND PAY FOR WATER METER, SIZE, AND LOCATION AS INDICATED IN THE PLANS.

15. POINT OF CONNECTION SHALL BE AS INDICATED IN THESE PLANS. THE CONTRACTOR SHALL MAKE CAUSE, ARRANGE FOR, AND PAY ALL COSTS FOR EXTENDING ELECTRICAL POWER FROM EXISTING UTILITY COMPANY SOURCE TO CONNECTION POINT.

16. WHEN WORKING UNDER THE DRIP LINE OF EXISTING TREES, THE CONTRACTOR SHALL USE ALL POSSIBLE CARE TO AVOID INJURY OF TREES AND TREE ROOTS. WHERE A DITCHING MACHINE IS RUN CLOSE TO TREES HAVING ROOTS SMALLER THAN TWO INCHES (2") IN DIAMETER, THE WALL OF THE TRENCH ADJACENT TO THE TREES SHALL BE HAND TRIMMED, MAKING CLEAR CUTS THROUGH THE ROOTS. STOCKPILING OF EARTH OR BUILDING MATERIALS WITHIN THE DRIP LINE OF TREES IS PROHIBITED.

ALL CUTS THROUGH ROOTS ONE-HALF INCH (1/2") AND LARGER IN DIAMETER SHALL BE CUT CLEAN WITH A PRUNING SAW. TRENCHES ADJACENT TO TREES SHALL BE FILLED WITHIN 24 HOURS AFTER EXCAVATION, BUT WHERE THIS IS NOT POSSIBLE, THE SIDE OF THE TRENCH ADJACENT TO THE TREE SHALL BE KEPT SHADED WITH DAMPENED BURLAP OR CANVAS.

ROOTS OF TWO INCH (2") OR LARGER DIAMETER, WHEN ENCOUNTERED, SHALL BE IMMEDIATELY REPORTED TO THE LANDSCAPE ARCHITECT WHO WILL DECIDE WHETHER THE CONTRACTOR SHALL CUT THE ROOT IN ACCORDANCE WITH THE ABOVE PARAGRAPH OR SHALL HAND TUNNEL UNDER AND PROTECT ROOT WITH A WRAPPING OF DAMPENED BURLAP. IN THE LATTER EVENT, THE CONTRACTOR SHALL BE COMPENSATED FOR THE ADDITIONAL COST.

UtahStateUniversity

Eaglewood Golf Course Renovations

1110 E Eaglewood Dr., North Salt Lake, UT 84054

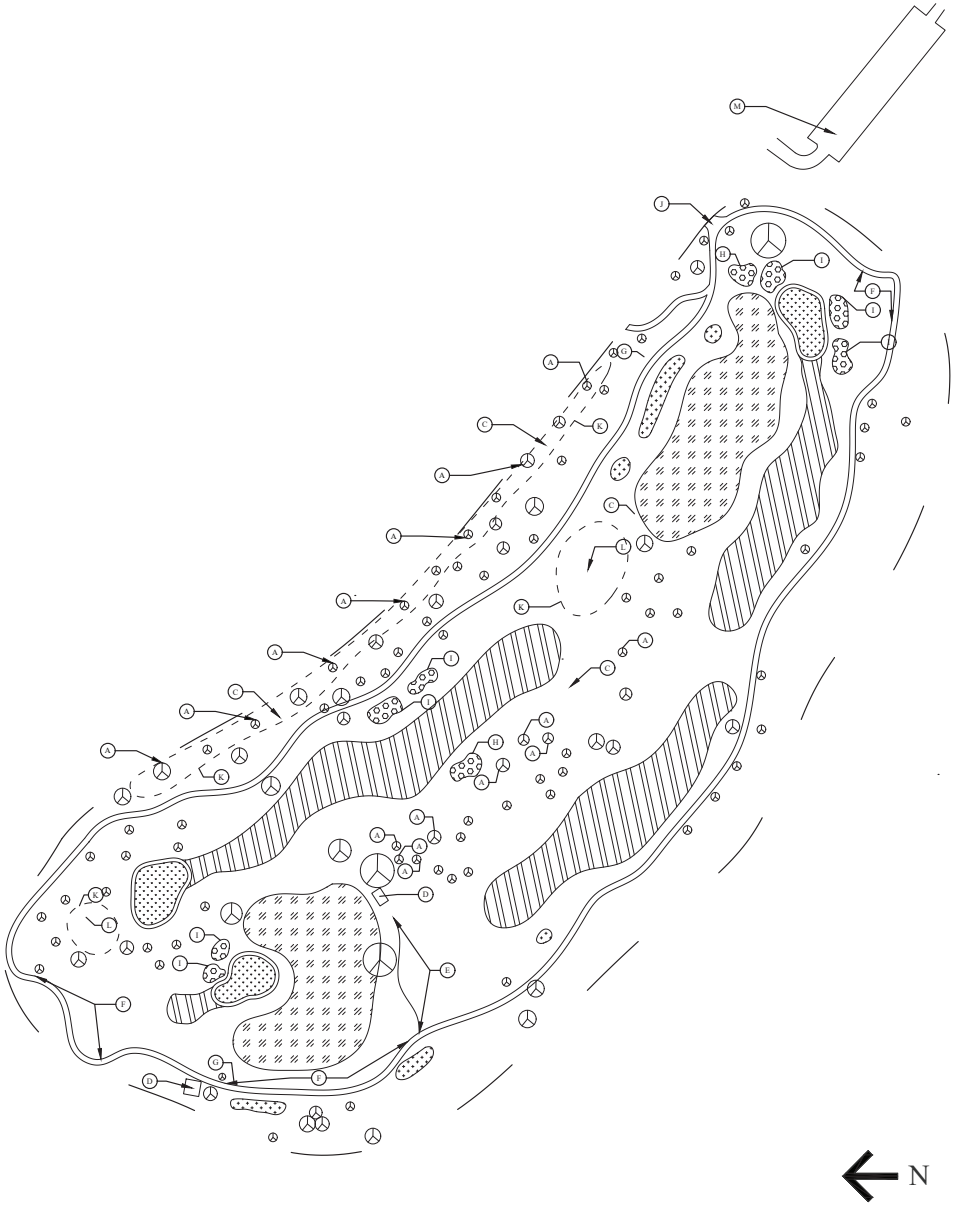
Designer
Foster Cook

Client
LAEP 4110
Construction Documents

Date
March 12, 2020

L1
COVER SHEET

Appendix
Construction Documents: Site Preparation & Demolition Plan



N

SITE PREPARATION & DEMOLITION NOTES

1. THE CONTRACTOR SHALL PERFORM ALL CLEARING, DEMOLITION, REMOVAL AND SITE PREPARATION NECESSARY FOR THE PROPER EXECUTION OF ALL WORK SHOWN ON THESE DRAWINGS AND DESCRIBED IN THE SPECIFICATIONS.
2. REMOVAL OF EXISTING PAVING AND CURBS SHALL INCLUDE ALL SUBBASE AND BASE ROCK REQUIRED TO INSTALL ITEMS SPECIFIED IN THE DRAWINGS AND SPECIFICATIONS.
3. EXISTING SITE TOPOGRAPHIC SURVEY BY COOK GOLF ARCHITECTS.
4. CONTRACTOR SHALL BE RESPONSIBLE FOR ADJUSTING ALL EXISTING UTILITY BOXES, MANHOLES, ETC. AS NECESSARY TO MEET FINISH GRADES SHOWN ON THE PLANS.
5. ALL EXISTING MISCELLANEOUS STREET SIGNS ON THE SITE SHALL BE CAREFULLY REMOVED BY THE CONTRACTOR AND STORED PRIOR TO THE START OF ANY DEMOLITION WORK, REPLACE OR RE-INSTALL SIGNS AS DIRECTED BY THE CITY INSPECTOR AFTER THE COMPLETION OF GRADING OPERATIONS.
6. ALL TREES NOTED ON THE PLAN TO BE REMOVED SHALL BE REMOVED FROM THE SITE, INCLUDING THE TRUNK AND ROOTS, TO A DEPTH OF 12" BELOW FINISHED GRADE.
7. ALL TREES NOT NOTED ON THE PLAN TO BE REMOVED SHALL BE PROTECTED AND PRESERVED, INCLUDING THE TRUNK AND ROOTS, ACCORDING TO DETAIL 6. (SEE SHEET L6 DETAIL 07)
8. THE CONTRACTOR SHALL SUBMIT A LIST OF EQUIPMENT TO BE REMOVED (DRAIN INLETS AND GRATES, CHAIN LINK FENCING, POSTS AND RAILS, IRRIGATION EQUIPMENT, ETC.) THE EXISTING EQUIPMENT LIST SHALL BE PRESETNED TO THE OWNER'S REPRESETATIVE FOR REVIEW PRIOR TO COMMENCEMENT OF ANY WORK. THE OWNER'S REPRESENTATIVE SHALL DETERMINE THE VALUE OF ANY MATERIAL FOR REUSE BY THE OWNER AND DIRECT THE CONTRACTOR TO EITHER DISPOSE OF THE EQUIPMENT (OFFSITE) OR PRESENT MATERIAL TO THE OWNER (ONSITE).
9. REMOVAL OF PAVED AREA SHALL INCLUDE ALL SUBBASE AND BASE ROCK AS NECESSARY TO INSTALL PAVING SECTION INDICATED ON THESE DRAWINGS. WHERE THE EXISTING PAVED AREA OCCURS IN AREAS TO BE PLANTED, THE EXISTING PAVING SUBBASE, AND BASE ROCK SHALL BE COMPLETELY REMOVED.
10. THE CONTRACTOR SHALL BE AWARE OF AND RESPONSIBLE FOR EXISTING IRRIGATION SYSTEM DURING THE COURSE OF CONTRACT. ANY HEADS, VALVES, QUICK COUPLERS, OR OTHER PARTS OF THE SYSTME DAMAGED DURING ALL OPERATIONS SHALL BE REPLACED BY CONTRACTOR AT NO COST TO THE OWNER.
11. THE TYPES, LOCATIONS, SIZES AND/OR DEPTHS OF EXISTING UNDERGROUND UTILITIES AS SHOWN ON THE IMPROVEMENT PLANS WERE OBTAINED FROM SOURCES OF VARYING RELIABILITY. THE CONTRACTOR IS CAUTIONED THAT ONLY ACTUAL EXCAVATION WILL REVEAL THE TYPES, EXTENT, SIZES, LOCATIONS AND DEPTHS OF SUCH UNDERGROUND UTILITIES WHICH MAY BE ENCOUNTERED, BUT WHICH ARE NOT SHOWN ON THESE DRAWINGS.
12. ALL GREEN COMPLEXES, FAIRWAYS AND TEE BOXES ARE TO BE UNDISTURBED BY THE CONTRACTOR AND IF DAMAGED MUST BE RESTORED TO PRECONSTRUCTION CONDITIONS.

HATCH LEGEND

- GREENS -- PROTECT
- FAIRWAYS -- PROTECT
- WATER
- BUNKERS
- TEE BOXES -- PROTECT

CALLOUT LEGEND

- (A) EXISTING TREES -- REMOVE
- (B) EXISTING TREES -- PRESERVE
- (C) UTILITY BOX -- PRESERVE & PROTECT
- (D) PUMPHOUSE -- PRESERVE & PROTECT
- (E) EXISTING CART PATH -- REMOVE
- (F) EXISTING CART PATH -- PREPARE FOR CURBING
- (G) EXISTING SIGNAGE -- PRESERVE AND PROTECT
- (H) BUNKER -- REMOVE
- (I) BUNKER -- PRESERVE & PROTECT
- (J) SITE ACCESS FOR CONSTRUCTION
- (K) EXISTING ROUGH GRASS -- CLEAR AND GRUB
- (L) EXISTING DRAIN INLET -- PRESERVE AND PROTECT
- (M) TEMPORARY STORAGE FOR CONSTRUCTION EQUIPMENT (PARKING LOT TO EAST OF SITE)

UtahStateUniversity

Eaglewood Golf Course Renovations

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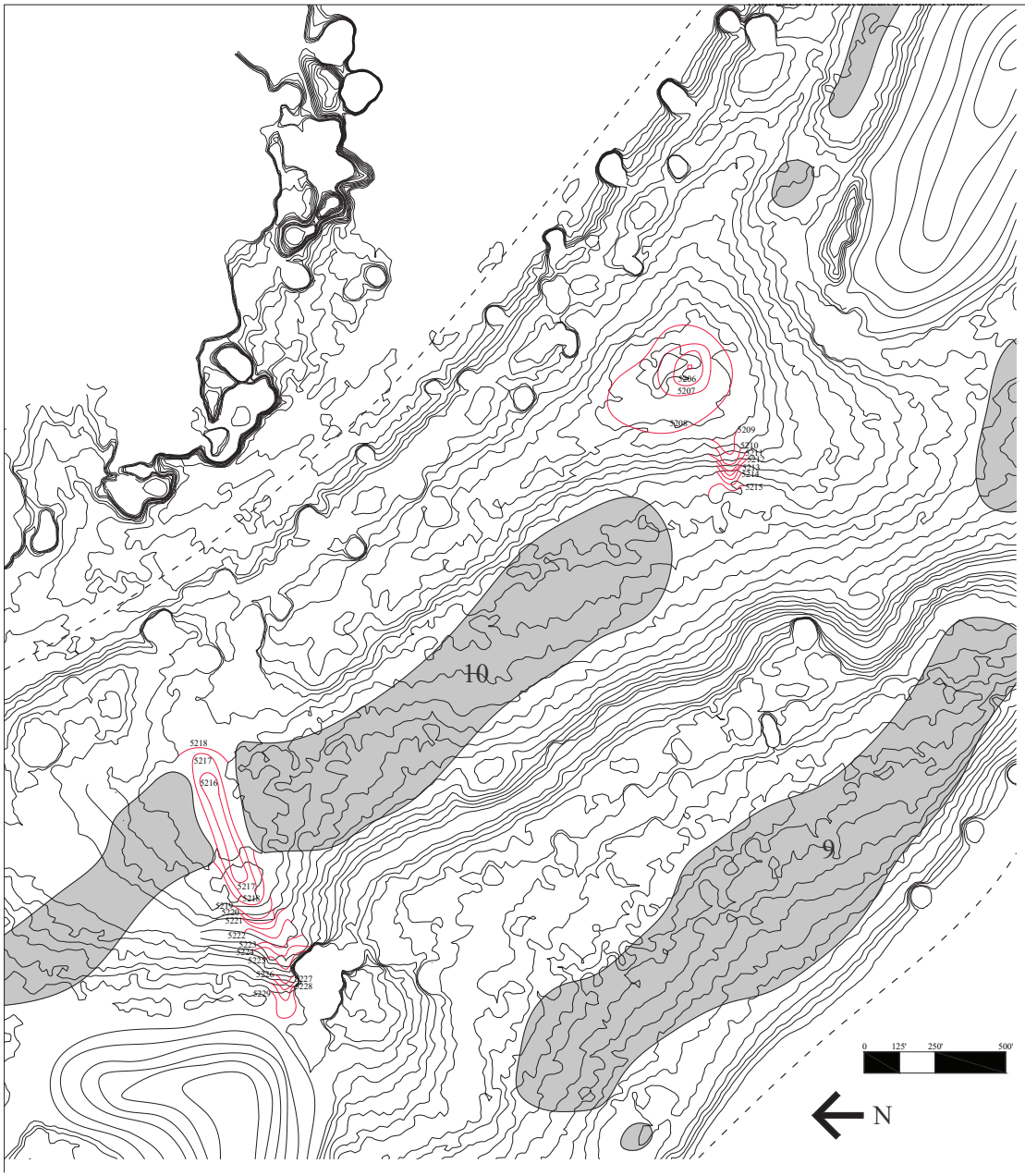
Designer
Foster Cook

Client
LAEP 4110
Construction Documents

Date
April 28th, 2020

L2
SITE PREP & DEMO

Appendix
Construction Documents: Grading Plan



GRADING AND DRAINAGE NOTES

1. GRADIENT OF LAWN AREAS SHALL NOT EXCEED ONE FOOT OFVERTICAL CHANGE IN FOUR FEET OF HORIZONTAL DISTANCE.
2. GRADIENT OF GROUNDCOVER AREAS AND ROADSIDE FLOWER MIX SHALL NOT EXCEED ONE FOOT OF VERTICAL CHANGE IN THREE FEET OF HORIZONTAL DISTANCE.
3. GRADING SHALL BE SMOOTH AND NATURAL IN APPEARANCE TO BLEND WITH EXISTING TOPOGRAPHY.
4. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, DISTANCES, AND GRADES IN THE FIELD AND BRING ANY DISCREPANCIES TO THE ATTENTION OF THE OWNER'S REPRESENTATIVE FOR A DECISION PRIOR TO COMMENCING WITH THE WORK.
5. THE CONTRACTOR SHALL PROVIDE POSITIVE SURFACE DRAINAGE IN ALL LANDSCAPE AREAS (1% MIN. FLATWORK AREAS, MIN. 2% AT PLANTING AREAS) AND SHALL BRING ANY DISCREPANCIES TO THE ATTENTION OF THE OWNER'S REPRESENTATIVE FOR A DECISION BEFORE CONTINUING WITH THE WORK.
6. THE CONTRACTOR SHALL REMOVE FROM THE SITE ALL DEBRIS AND UNSUITABLE MATERIAL GENERATED BY HIS OPERATIONS.
7. THE CONTRACTOR SHALL COORDINATE THE AREA DRAINS AND PERFORATED DRAIN LINE SHOWN ON THESE PLANS WITH THE CIVIL ENGINEER'S DRAWINGS. ALL CONNECTION, INVERT, AND FLOWLINE INFORMATION SHALL BE AS SHOWN ON THE CIVIL ENGINEER'S DRAWINGS.
8. THE CONTRACTOR SHALL PROTECT ALL EXISTING DRAINAGE PATTERNS AND ASSURE PROPER DRAINAGE AWAY FROM THE BUILDINGS. AREAS DISTURBED BY THE CONTRACTOR SHALL BE REGRADED AND BLENDED INTO THE EXISTING, UNDISTURBED SITE.
9. CUTS AND FILLS HAVE BEEN DESIGNED TO BALANCE. IN THE EVENT OF IMBALANCE, THE CONTRACTOR SHALL ADJUST THE GRADES WITHIN THE SITE AS DIRECTED BY THE OWNER'S REPRESENTATIVE TO ACHIEVE SITE BALANCE. NO IMPORT FILL WILL BE REQUIRED.
10. GRADIENT SHALL NOT EXCEED 1'-0" OF VERTICAL CHANGE IN 4'-0" OF HORIZONTAL DISTANCE.
11. PRIOR TO CONSTRUCTION OF ANY DRAINAGE WORK, CONTRACTOR SHALL DETERMINE DEPTHS OF EXISTING UTILITY LINES AT LOCATIONS WHERE STORM DRAIN LINES CROSS UTILITY LINES. IN THE EVENT OF A CONFLICT OF ELEVATION BETWEEN NEW STORM DRAIN LINE AND EXISTING UTILITY, NOTIFY OWNER'S REPRESENTATIVE IMMEDIATELY. THE OWNER'S REPRESENTATIVE WILL PROVIDE THE CONTRACTOR WITH A PLAN INDICATING ADJUSTED VERTICAL ELEVATIONS OF STORM DRAIN LINE. AFTER RECEIPT OF ADJUSTED STORM DRAIN ELEVATIONS AND APPROVAL OF THE OWNER, CONSTRUCTION OF THE STORM DRAINAGE SYSTEM MAY PROCEED.
12. CONTRACTOR TO VERIFY ALL EXISTING INVERT ELEVATIONS FOR STORM DRAIN AND SANITARY SEWER CONSTRUCTION PRIOR TO ANY SITE WORK. ALL WORK FOR STORM AND SANITARY INSTALLATION SHALL BEGIN AT THE DOWNSTREAM CONNECTION POINT. THIS WILL ALLOW FOR ANY NECESSARY ADJUSTMENTS TO BE MADE PRIOR TO THE INSTALLATION OF THE ENTIRE LINE. IF THE CONTRACTOR FAILS TO BEGIN AT THE DOWNSTREAM CONNECTION POINT AND WORKS UP STREAM, HE SHALL PROCEED AT HIS OWN RISK AND BE RESPONSIBLE FOR ANY ADJUSTMENTS NECESSARY.
13. WHERE A SWALE IS SHOWN BY CONTOURS ALONG PATH, PATH SHALL PITCH 1-1/2% TO SWALE. IF NO SWALE IS SHOWN BY CONTOURS, PATH SHALL PITCH 1-1/2% IN DIRECTION OF GENERAL SLOPE OF TOPOGRAPHY.
14. ADJUST FINISH GRADES AS NECESSARY AT EXISTING VALVE BOXES, AND MANHOLES FOR A FINISH CONDITION.
15. SET ADJACENT A.C. PAVING GRADES 6" BELOW TOP OF CURB.
16. GRADE SMOOTH, NATURAL APPEARING TRANSITION FROM FINISH GRADE TO EXISTING GRADE AT BASE OF EXISTING TREES. MAINTAIN EXISTING GRADE A MINIMUM OF SIX FEET (6') FROM TRUNKS.
17. REFER TO CIVIL ENGINEER'S PLANS FOR FINISH GRADES OF ALL WALKS AND WALLS AND LOCATION AND ELEVATIONS OF ALL DRAIN INLETS.

LEGEND

- EXISTING CONTOURS
- PROPOSED CONTOURS
- PROJECT BOUNDARY
- GOLF HOLE FEATURE OUTLINES
- EXISTING DRAIN INLET

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North Salt Lake City

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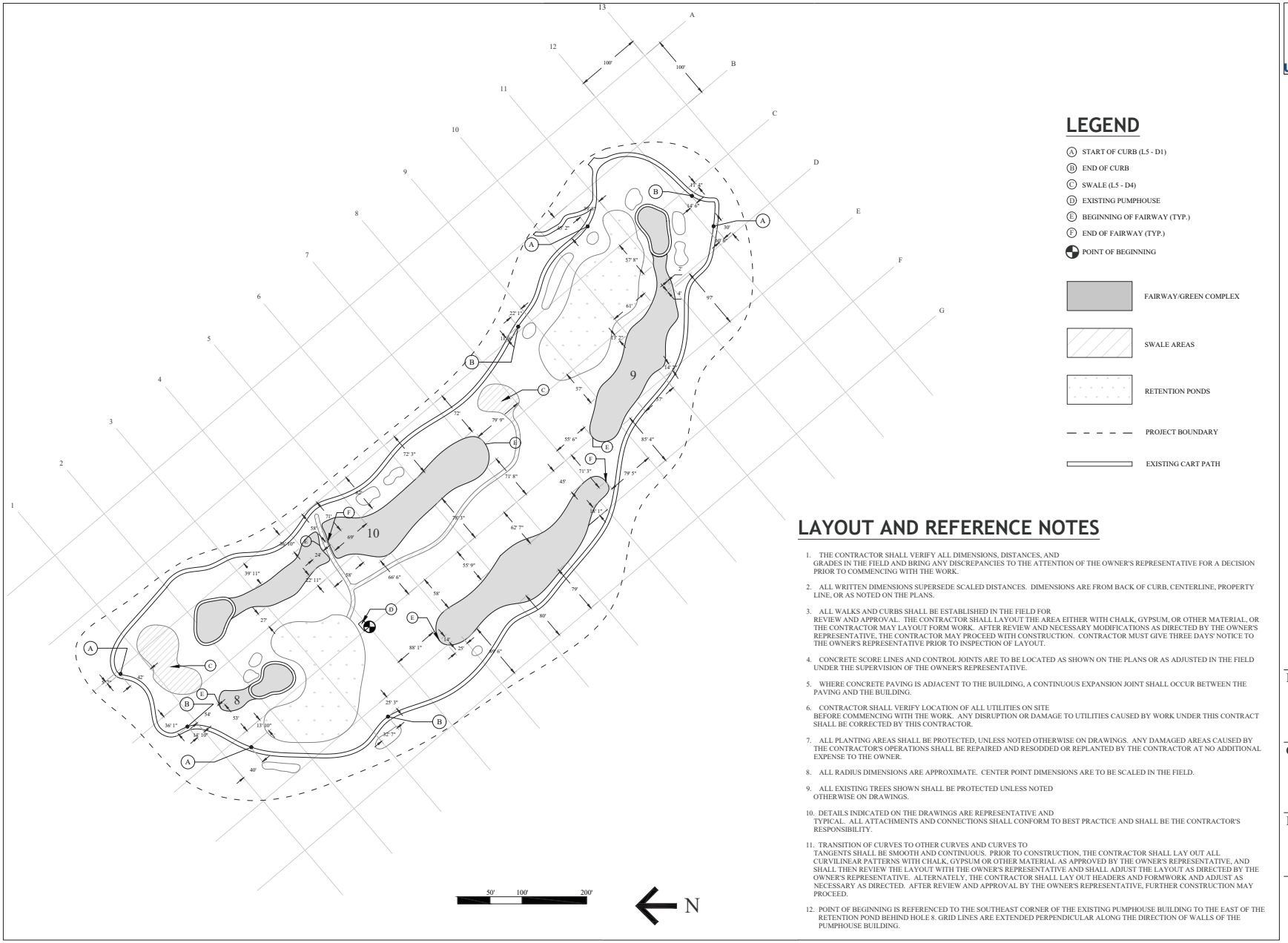
L3
GRADING PLAN

Appendix
Construction Documents: Layout & Reference Plan



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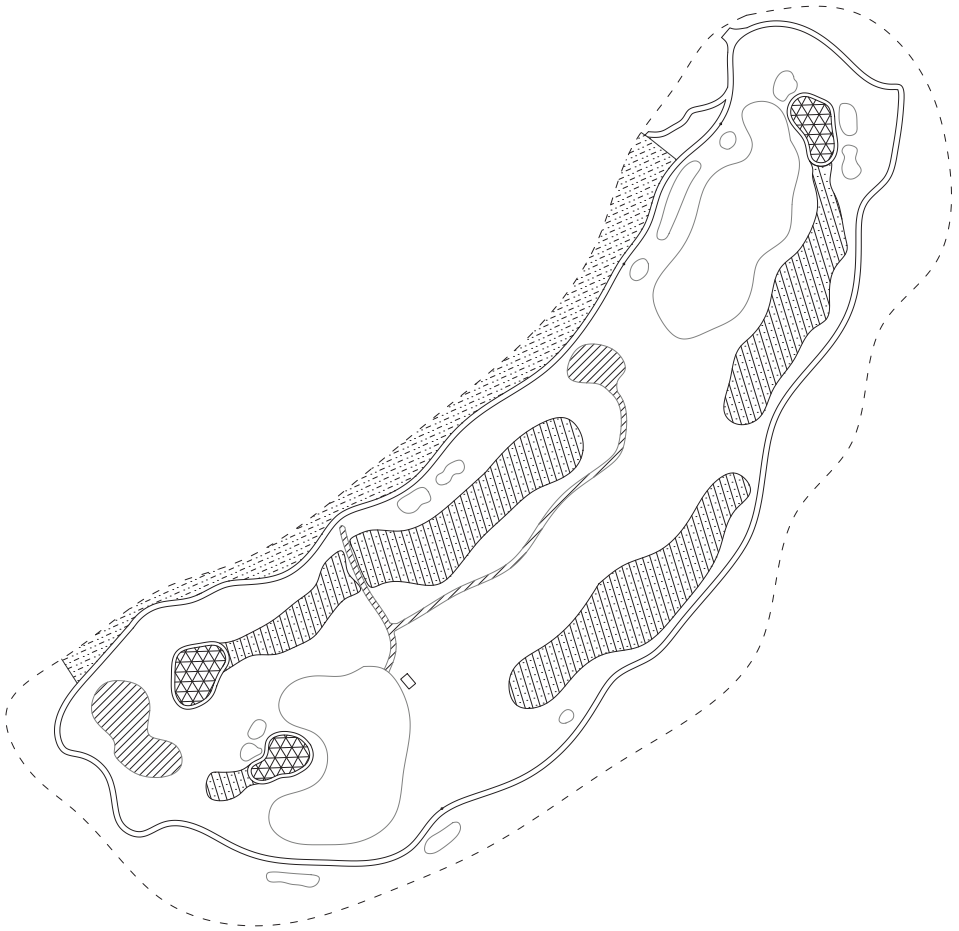
L5 LAYOUT & REFERENCE PLAN

Appendix
Construction Documents: Grassing Plan



GRASSING LEGEND

FEATURE	GRASS	METHOD
SWALE AREAS	NATIVE MIX/SHRUBS	SEEDED/PLANTED
GREEN	CREEPING BENTGRASS	SEEDED
FAIRWAY	KENTUCKY BLUEGRASS/PERENNIAL RYEGRASS MIX	SOD
NATIVE AREAS	CRESTED WHEATGRASS/NATIVE MIX	SEEDED

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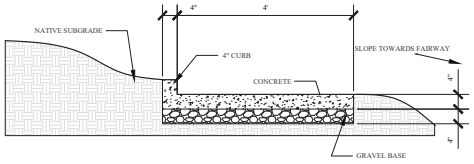
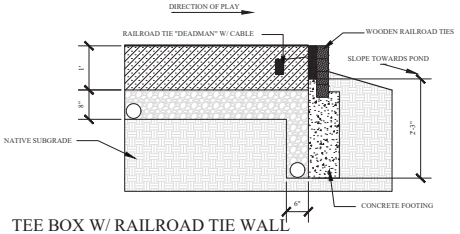
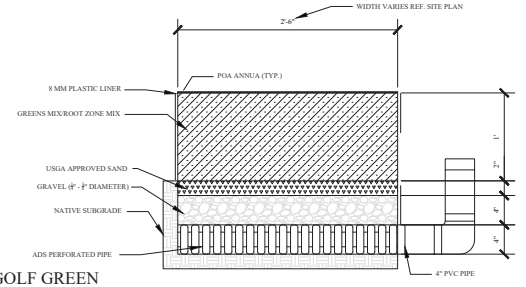
L5
GRASSING PLAN



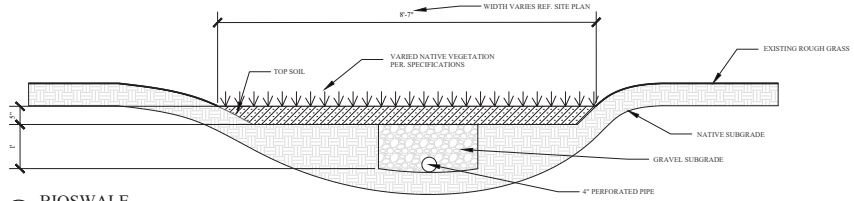
01 CONCRETE CART PATH W/ CURB



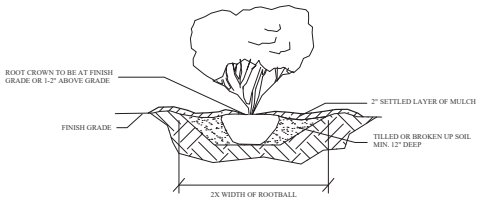
02 TEE BOX W/ RAILROAD TIE WALL



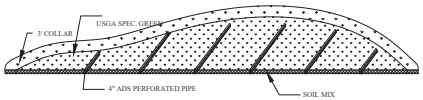
03 GOLF GREEN

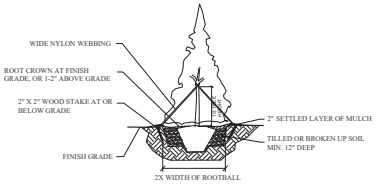


04 BIOSWALE

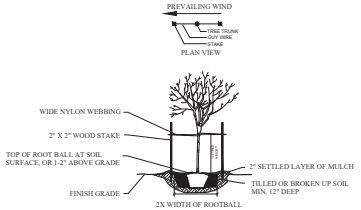


06 SHRUB PLANTING

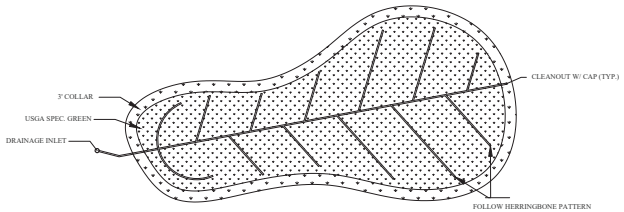




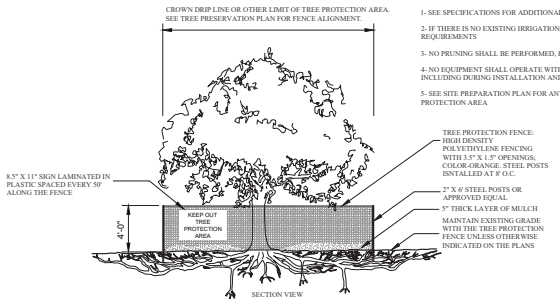
07 LARGE TREE PLANTING



08 SMALL TREE PLANTING



05 GOLF GREEN DRAINAGE SYSTEM



NOTES:

1- SEE SPECIFICATIONS FOR ADDITIONAL TREE PROTECTION REQUIREMENTS

2- IF THERE IS NO EXISTING IRRIGATION, SEE SPECIFICATIONS FOR WATERING REQUIREMENTS

3- NO PRUNING SHALL BE PERFORMED, EXCEPT BY AN APPROVED ARBORIST

4- NO EQUIPMENT SHALL OPERATE WITHIN THE PROTECTION FENCING INCLUDING DURING INSTALLATION AND REMOVAL

5- SEE SITE PREPARATION PLAN FOR ANY MODIFICATIONS WITH THE TREE PROTECTION AREA

09 TREE PROTECTION

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L6
CONSTRUCTION DETAILS