Golf Course Drainage Improvements Through Natural Processes

History of Environmental and Societal Justice In Golf

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

According to the United States Environmental Protection Agency, trends have shown a consistent increase in rainfall and severity of rainstorms over the last 120 years. Stormwater runoff from these storms causes erosion, carrying fertilizer, oil, pesticides, dirt, and bacteria in its wake. This polluted runoff is one of the greatest threats to clean water in the United States, as noted by the EPA. Polluted waterways and drinking water have severe negative impacts on human and environmental health. Golf courses are a massive contributor to polluted stormwater runoff and waterways, and are general abusers of environmental resources. My research aims to analyze the current negative impacts that golf courses have on the environment from stormwater runoff and erosion, as well as address mitigation tactics for these issues to improve both water quality and quantity My capstone project is dealing with a similar issue at MeadowCreek Golf Course, with stormwater drainage, runoff, and erosion issues near the 17th hole. . To fully understand the effects that golf courses have on the environment, further research will address the impacts that construction has on the environment during the building phase of golf courses. The analysis of construction erosion mitigation tactics is related to my major by applying these techniques to the real world.

Despite the public believing that recreational golf courses are visually appealing and contribute to their natural environment, in most cases, they contribute to human and environmental injustices (Wurl, 2019). According to the Chesapeake Bay Foundation (CBF) because of polluted runoff, golf courses reshape waterways, endanger aquatic life, lower drinking water quality, and contaminate recreational areas. Golf courses are usually geographically close to residential communities, and therefore directly cause the environmental downfall of the entire community that surrounds it. Where developers may argue that constructing a golf course in a local area is a propellant for the economy, others would argue that

it creates more injustices. Less available drinking water, rising costs in housing, pollution of soils and aquifers, as well as human discrimination create an even larger divide between higher and lower economical classes. In my STS research, I intend to explore the societal and environmental injustices created from golf courses, and the history of unethical practices associated within the industry.

With analyzing stormwater runoff and erosion from golf courses, the next question to explore is the human and environmental injustices that take place in local communities. With degradation of ecological systems, human life is therefore affected as a society. The technical question I aim to address is are natural stormwater management treatments and drainage techniques the most effective to combat the issue of erosion, water quality, and water quantity that golf courses are facing today? The STS topic I aim to address is how these environmental malpractices affect local communities, the divide between perception of golf courses, and addressing if enough is being done to promote inclusivity and protection within the industry. In addressing the environmental challenges that golf courses face such as erosion, water quality degradation, and excessive water use, this paper investigates whether natural stormwater management treatments and drainage techniques provide the most effective solution. Beyond their environmental impact, these issues are deeply intertwined with the social effects on surrounding communities, shaping the public's perception of golf courses. Consequently, this essay also explores whether current efforts within the industry are sufficient to bridge the perception divide and promote inclusivity.

Technical Topic

The technical question through research is: are natural stormwater management treatments and drainage techniques the most effective to combat issues of erosion, water quality, and water quantity that golf courses are facing today? Or is infrastructure required to fully combat these issues? To fully assess the environmental impact that golf courses have, the first step is to analyze the effects of stormwater runoff to local waterways and the environment through the construction phase. During construction of golf courses, disturbing earth removes natural vegetation that protects soil, causing an increase in soil detachment and leading to sediment discharge running off site and into neighboring stormwater bodies of water (Roche et al., 2024). According to Roche et al., sediment-saturated stormwater runoff can cause negative impacts on water quality by carrying toxic substances to local waterways. A common mitigation tactic is the use of silt fences, which are installed around the site in which construction is taking place, trapping sediment, and reducing stormwater flow and velocity. However, silt fences have only been tested in the southeast, providing areas of uncertainty for those who live in other parts of the country.

The next step in analyzing the environmental impacts of golf courses is to understand the implications golf courses have post-construction. The 17th hole at MeadowCreek Golf Course is facing an issue of overtopping. The ponds, basins, and streams that are present in this area cannot effectively treat or handle the stormwater runoff. This is causing the golf course to get flooded, and therefore run into the Rivanna River, bringing a vast amount of unnecessary nutrients to the local waterway. It is noted that when nitrogen and phosphorus, the two main ingredients in fertilizer, runoff into local waterways, algal blooms occur. When this event becomes present, dissolved oxygen is no longer available, causing aquatic life to die (Beecham, 2007). The runoff from MeadowCreek is also causing a concurring expansion of a headcut that is eating onto the green, near the location of where players are. This causes an increase in safety risk due to loose

ground that can collapse at any given moment. The goal is to improve the drainage principles through erosion and sediment control, and stormwater management system practices. Researchers have noted that natural vegetation, conveyance systems, and increasing the amount of water holding basins are all natural ways to prevent stormwater runoff from getting into local waterways and to be treated directly on site.

To conduct this research, my capstone team and I will be exploring and producing a solution to the stormwater drainage issues at the 17th hole. Our team is working closely with the public and environmental health consulting firm, Hazen and Sawyer. Water quality assessments, watershed assessments, feasibility studies, and schematic design drawings will help us deliver an effective way to manage the stormwater management issues that the golf course is facing.

STS Topic

While technical solutions like natural stormwater management and drainage techniques are essential in addressing the environmental issues that golf courses face, their impacts extend beyond the ecological sphere. These methods not only shape the environmental sustainability of golf courses but also influence how local communities perceive and are affected by these spaces, highlighting the need for inclusive and responsible industry practices. Therefore, I will be diving into the societal and environmental injustices that arise from the presence of golf courses, as well as the ethical issues that have persevered through history. Is enough being done, or are there areas in need of drastic change? To answer this question, I will be exploring the injustices as well as the methods in which golf courses are taking to increase its inclusivity and mitigate its negative implications both to the physical environment and human society.

It is important to note that different social groups in the vicinity of golf courses perceive golf courses as completely different entities. On one hand, developers of these areas believe that

golf courses are a way to benefit their local communities economically. Such a scenario is present in Los Cabos, Mexico, where golf course construction and maintenance has a massive impact within the region. It is noted in Los Cabos, Mexico, there is a growth rate of 8.1%, with the highest percentage (80.7%) of foreign tourists in relation to the total arrivals at the national level (Wurl, 2019). These courses have become a standard component in the development of their coastal tourism, increasing the revenue in the area. The other perception, such as the tourist in this case, perceives the golf course as a space that classifies as a peaceful, quiet, and natural environment while on vacation. This in turn benefits both the developer and the tourists in a symbiotic relationship, contributing to the economic successes of their higher socio-economic status. However, golf courses present numerous challenges to those in the middle class. As concluded by the New York's Attorney General, citizens living near golf courses can be affected by dust blow-over from the golf course and seepage into their homes. Pesticides then seep into the groundwater, contaminating the drinking water available to them. This in turn creates a negative perception for the middle class, portraying that these areas are a threat to their way of life and overall physical health. Additionally, golf courses often occupy large swathes of land, usually in areas where real estate is limited. The United States alone contains about two million acres of land reserved by golf courses. That's enough land for more than 20 million units of medium density housing, solving California's current housing crisis (Jack, 2022). This raises questions about about whether the space could be used more equitably, especially when considering affordable housing, parks, or community centers that could serve broader purposes. On top of that, golf courses require significant amounts of water, fertilizers, and pesticides to maintain their aesthetic, leading to concerns about golf course water consumption. In areas where water is already scarce, golf courses can strain local resources, affecting both human and ecological populations. In a world where resources are finite and environmental crises are

intensifying, dedicating large portions of land and water to a leisure activity primarily for wealthy individuals raises significant ethical questions. Is it justifiable to prioritize recreational activities over more pressing social and environmental needs?

Private country clubs and golf courses have served as a primary networking hub for building and maintaining careers. But, within the history of golf, certain groups are denied access to these opportunities of growth. According to Hanna et al., the Professional Golfers' Association (PGA) and the Ladies Professional Golf Association (LPGA) implemented nondiscrimination standards for all tournament sites to follow. However, researchers found that after these standards were implemented, most private clubs refused to share the breakdown of their memberships by race and gender. Of the 8 clubs that shared, less than 3 percent of each club's memberships were African-American and less than 10 percent of nearly all memberships were Asian or Hispanic (Hanna et al., 2012). With the PGA Tour mostly containing private country clubs and courses, the status quo for the nondiscrimination standards implemented by the PGA and LPGA has not been met. The history of Augusta National Golf Course is used as an example of how the history of traditions highlight the denied access for opportunities of growth for people of color and women. The Augusta National Golf Course originated from a golfer named Bobby Jones, who was set out to build his dream golf course. The construction of this course commenced in 1931, and was born in January of 1933 (Margulis, 2015). The golf course then decided to have its own tournament, which is now called "The Masters" today, and a part of the PGA. According to Margulis, many legendary names have come to The Masters, but almost all of them have been white, with little to no African-American competitors at Augusta National. This contains a direct correlation with the history of this course, starting with the fact that African-American men were only allowed to be caddies for the white golfers competing the tournament. It took Augusta National almost 60 years to admit their first African-American

member. The first African-American women, Condoleezza Rice, was admitted to Augusta National in 2012. It is seen that there have been initial steps to reconcile the past, however there is much to be done to truly see an equitable sport for all to enjoy.

To conduct this research, I will be exploring the history of the PGA, as well as the environmental history of golf courses to understand the different perceptions and issues golf courses present to different social groups. To further prove my research, the theoretical framework I will be using is the social construction of technology (SCOT). The SCOT framework, developed by scholars like Wiebe Bijker and Trevor Pinch, argues that technological artifacts do not develop in isolation but are shaped by social groups with different interests, needs, and values. SCOT emphasizes that technology's meaning and impact are constructed through interactions among these groups, revealing how various social, cultural, and economic factors influence a technology's development, use, and societal impact. In the context of golf courses, SCOT can illuminate how different social groups, such as developers, local residents, tourists, and environmental advocates assign distinct meanings and purposes of golf course environments. For example, developers and tourists often perceive golf courses as economic assets or recreational spaces that enhance tourism and attract wealthier visitors. Meanwhile, nearby residents, especially those impacted by environmental and social inequalities, may view these courses as a misallocation of land, water, and equity, representing the application of the SCOT framework to golf courses, this paper includes a SCOT diagram below, visualized in

figure 1.

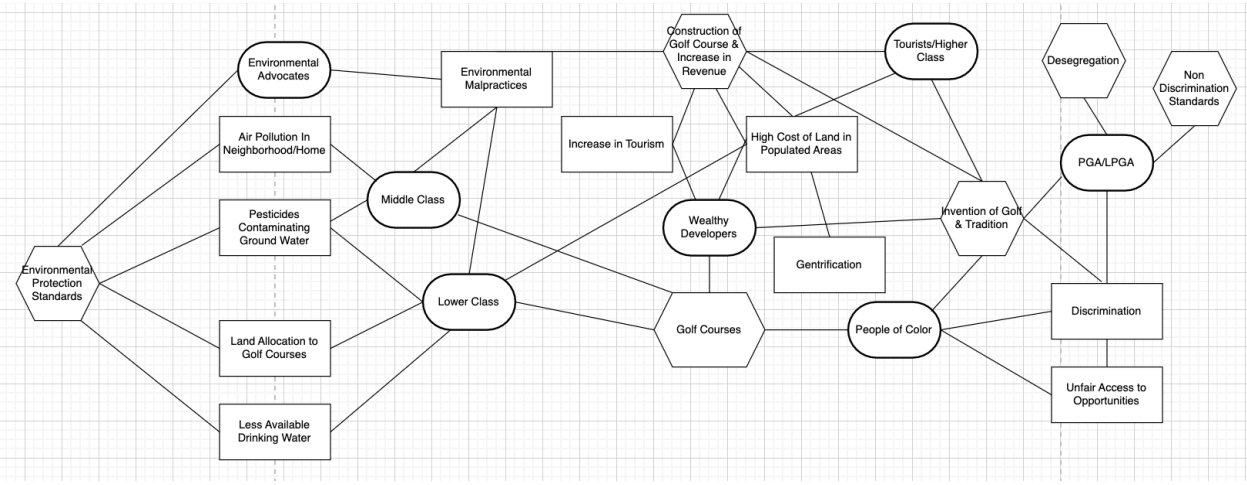

Fig. 1 SCOT Analysis for Golf Course Perceptions

This diagram visually maps out the various social groups involved, and highlights the diverse meanings each group attaches to golf courses. By illustrating the intersections and tensions between these perspectives, the diagram clarifies how these competing values shape decisions around golf course design, environmental practices, and community access.

Conclusion

The technical research will deliver the ideal drainage improvements and rehabilitation for MeadowCreek through on site research and schematic design. The STS research will deliver an understanding of the ongoing societal and environmental impacts on all parties involved, diving into the history of golf and its traditions. The research done will help evolutionize the drainage and erosion issues of golf courses, while also mitigating the negative impacts these areas have on local communities to promote sustainability and inclusivity. SCOT will explore the values of various social groups in society on how they perceive golf courses based on their socio-economic status. The combination of these two analyses will serve as a way for private or public clubs to

successfully combat environmental issues with effective stormwater management practices while reducing injustices that occur to the broader system in which they exist.

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