Sustainability in Soccer: Developing Eco-Friendly Models of Soccer Fields in LA Parks by Assessing The Benefits and Tradeoffs of Synthetic Turf and Grass Soccer Fields

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Fall 2022

Acknowledgments

I would like to thank my family, friends, advisors, and the beautiful game of soccer for helping me in this process and inspiring me to understand the intersections of soccer and urban planning.

Abstract

With the rapid growth of soccer in America, synthetic turf has become an increasingly popular field surface due to its drought-resistant capability and minimal maintenance requirements compared to grass fields. However, there is a lot of uncertainty around the environmental and physical safety of synthetic turf among stakeholders. This research aims to assess the benefits and tradeoffs of synthetic turf soccer fields and see if there are sustainable models to develop soccer-specific infrastructure in LA Parks. This research utilizes survey data, expert interviews, and GIS analysis to gather findings and create policy recommendations. The findings indicated that developing small-sided soccer fields in Los Angeles through Urban Soccer Park's infrastructural model, complete with containment netting, borders, and organic sand infill, is a valid potential solution for field maintenance and environmental concerns in public parks. The heat analysis found that small-sided synthetic turf soccer fields trap significantly less heat than full-sized synthetic turf soccer fields and interviews conveyed a high approval rating of small-sided soccer spaces. Findings also showed that environmental concerns around synthetic turf, like heat and chemical exposure, are real but can be mitigated in public parks through increased sustainability initiatives. The findings support recommendations to create a Los Angeles task force of experts that will develop regulations for synthetic turf use around field maintenance and environmental hazards and work with Urban Soccer Park's model to develop small-sided soccer fields throughout the city.

Introduction

"Soccer is, indeed, the most played sport in America. More school-age Americans play soccer than baseball, football, or anything else" (Veseth, 2006). This quote was from 2006, and the progression of soccer in America has exceeded the expectations of even the biggest soccer fans.

Soccer has become a common recreational sport in urban communities. In Los Angeles, soccer-specific spaces are as desirable as basketball courts which are reflected in the 110 public parks in Los Angeles that offer soccer-related activities compared to the 116 public parks that provide basketball-related activities (LA Parks, Accessed October 2022). Los Angeles, however, is park-poor; and with public sports infrastructure acting as a significant part of civic life and youth development, it is important to ensure that the spaces available are properly serving communities and working to be as sustainable as possible. (LA Parks, Accessed October 2022). That being said, with an increase in synthetic turf soccer fields, many environmentalists and community stakeholders question the environmental and physical risks of the material. Therefore, it is important to understand the benefits and tradeoffs of synthetic turf, given its increased use and concerns.

Since there is minimal research done on the impact of synthetic turf soccer fields in Los Angeles, this study brings soccer into conversation with sustainable infrastructure, climate change resilience, environmental policy, and community development to understand the significance of soccer-specific spaces in LA Parks. By doing so, soccer can be reimagined as an urban liveability indicator to allow for a wider consideration of the environmental, social, and physical impacts the sport has on communities. Understanding the type of field that will best intersect sustainability with community needs is crucial and this study will examine multiple

soccer fields of both public and private access, grass and synthetic surfaces, and varying field sizes.

This research employs a mixed-methods approach, drawing from interviews with various stakeholders such as city park experts, soccer coaches, and advocacy groups, and is augmented by heat mapping data of both synthetic turf and grass soccer fields. **By investigating the benefits and tradeoffs of synthetic turf soccer fields, this study aims to assess whether synthetic turf presents a sustainable and eco-friendly soccer field model for LA Parks.**

Background

The City of Los Angeles and Los Angeles County

The City of Los Angeles is unique and vast. It is home to roughly four million people and attracts countless numbers of tourists annually. The implications of urban sprawl can make differentiating between different regions of Los Angeles difficult. However, understanding this difference allows people to be more conscious of which local governments have jurisdiction over decisions like building soccer fields in public parks. Los Angeles County "covers ten million Angelenos and 88 different municipal governments which range in size from a few hundred (Vernon) to four million (City of Los Angeles)" (The LA 101 Guide, Accessed November 2022). All cities in the county have control over "housing and building, planning, zoning, and development," which includes public parks. For this reason, the project will use the park information from the City of Los Angeles Department of Recreation and Parks instead of Los Angeles County. However, because of how closely Los Angeles County and the City of Los

Angeles work together, the findings of this study are not exclusive to the city of Los Angeles and can have implications for the whole county.

Soccer Fields in LA Parks

Of the 318 general parks in the city of Los Angeles, 46 park spaces have soccer-specific facilities that have been created for the public to play soccer. In total, the city of Los Angeles has 39 synthetic turf soccer spaces listed on its database, with some of these spaces containing multiple fields. In 2013, the city reported having 21 synthetic turf soccer spaces (LA Parks, Accessed November 2022). While there are many big green spaces in public parks where people can and do play soccer, these spaces were not built for the sole intention of playing soccer. Therefore, this study will examine parks with soccer-specific synthetic turf or grass spaces to better understand the planning that goes into development, maintenance, and also workshop methods to incorporate sustainability models for surrounding communities. Another important definition is what is included in the term "soccer field." For this study, a soccer field will include two types of fields: full-sized and small-sided fields. A full-sized soccer field refers to the traditional soccer field used for 11 vs. 11 games. Small-sided soccer fields, however, can be described as soccer fields meant for games with fewer people than the traditional 11 vs. 11 structure. Dimensionally, small-sided fields can range in size, but are roughly 4500 square feet, depending on available space or desired field size (LA Parks, Accessed November 2022).

Drought in Los Angeles

Los Angeles, like many desert regions in the United States, is experiencing serious drought issues. California is currently in its driest period on record, and the implications of this led to the State Water Resources Control Board reducing its water use by up to 30% (Greene and

Lauder, 2022). Statistics from the National Integrated Drought Information System state that 100% of people in Los Angeles County experience drought, with 73.04% of the county's land categorized under "extreme drought" and 24.14% of the county's land categorized under "severe drought" (Accessed November 2022). In 2015, journalist Hillel Aron stated in the LA Weekly that the city of Los Angeles would be replacing "nearly all its 100 grass soccer fields with artificial turf" (Accessed September 2022). This is not surprising considering that a single field uses between "1 million to 3.5 million gallons of water annually" (Aron, Accessed September 2022). With this in mind, this paper will explore the stigmas and data behind the impacts that synthetic turf surfaces have on communities as Los Angeles continues to transition to synthetic turf to battle drought.

Defining Accessibility

Accessibility is generally defined as "the quality of being able to be reached or entered." While this is an important part of this study, accessibility within sports goes deeper than reaching or entering something. In this study, 'accessibility' will encompass the experience of the people while using the facility. This is important because even if a field can be reached or entered, what use is it if the quality of the field is poor? Most people would not consider going to a field that is barely usable just because it is open. Furthermore, how does the surface of the field, whether it is synthetic turf or grass, impact the experience of the people using it? Bringing 'accessibility' into sports literature by understanding the maintenance behind different field surfaces, as well as the opinions on the quality of public field surfaces will be very informative in incorporating sustainability within public soccer fields.

The Role of Schools in Synthetic Turf Spaces

With the limited park space in Los Angeles, it is not practical to expect the city to build a large number of new public soccer ields. Instead, programs like “Schools as Parks” aim to provide communities with extra public park space by using school facilities already in place (Edelhart, 2022). This initiative, spearheaded by Mike Bonin, pushes for school green spaces and playgrounds to be open to the public for extended hours and on the weekend instead of being locked (Edelhart, 2022). While this initiative has been implemented in wealthier areas of the city like Westchester, as well as previously adopted by the neighboring Pasadena, this policy has never reached the park-poor Los Angeles Promise Zone despite an apparent atmosphere of community and government support (Bonilla et al., 2016). Since soccer is such a popular sport in Los Angeles, most public schools have soccer fields already built. These fields tend to be multi-purpose synthetic turf fields that allow for soccer, football, and other sports to be played. However, with the uncertainty of the environmental risks of synthetic turf, would introducing these fields as an increased public space be harmful to communities? Analyzing and understanding the environmental and physical risks of synthetic turf compared to grass will hopefully provide a more equitable and sustainable route to increase public spaces in Los Angeles.

State Action Against Synthetic Turf

There are certain bills across multiple states heavily regulating or banning synthetic turf. There are currently two bills in California’s Senate that are seeking to ban or heavily regulate synthetic turf, SB 414 and SB 499. If put into law, SB 414 would prohibit a city, county, or district from “issuing a rebate, voucher, or other financial incentives for the use of synthetic turf”

that contains plastic and harmful carcinogens (California Legislative Information, Accessed April 2023). Specifically, per-and poly-fluoroalkyl substances (PFAS), a large group of human-made substances that do not occur naturally in the environment and are resistant to heat, water, and oil (California Legislative Information, Accessed April 2023). The Senate Committee on Governance and Finance noted that PFAS exposure can happen from a multitude of sources and "have been widely used as surface coatings and protectants in consumer goods such as carpet and home textiles; clothing; food packaging; and non-stick cookware" (California Legislative Information, Accessed April 2023). CASB 499 is aiming to ban synthetic turf installation in elementary schools or daycare facilities and is scheduled for a senate hearing on April 24, 2023 (California Legislative Information, Accessed April 2023). Outside of California, Maryland House Bill 1098 from the 2020 session asks that certain funds be authorized under Program Open Space to be "used for the maintenance and upkeep of certain grass athletic fields and drainage systems on land owned by the State" (Maryland General Assembly, Accessed April 2023). Maryland also has a Senate Bill, BB 0321, that aims to track the chain of custody of synthetic turf from manufacturer to installation, and removal (Maryland General Assembly, Accessed April 2023).

As Tom Perkins notes in an article for The Guardian, Boston recently became " the largest municipality in a small but growing number around the nation to limit use of synthetic turf" (Perkins, Accessed April 2023). This is following Mayor Michele Wu ordering the city to stop investing in synthetic turf installation in public parks. Notably, the mayor highlighted PFAS as a major concern with synthetic turf as a lack of studies have yet to understand how PFAS can move from synthetic turf to children and adults, leading to a lot of uncertainty in the synthetic turf industry (Perkins, Accessed April 2023).

Past Example of Sustainably Developed Park Spaces

In 2009, the City of Los Angeles Department of Recreation and Parks completed its Citywide Community Needs Assessment, and among many things found that “many communities do not have parks within a reasonable distance” (LA Parks, Accessed October 2022). The areas with the biggest isolation from parks were densely populated communities of color that were being displaced and negatively impacted by the city's urban growth. To combat this, the city created the 50 Parks program with the purpose of “substantially increasing the number of parks and facilities available across the City, with a specific focus on densely populated neighborhoods and communities that lack sufficient open space and recreational services” (LA Parks, Accessed October 2022). To properly fund this program, the city opted to create smaller-sized parks of about 5,000 to 20,000 square feet that would cost between $250,000 to $700,000 and take four to six months to develop (LA Parks, Accessed, October 2022). Any additional costs would depend on possible extra amenities added to the park (Playcore, Accessed October, 2022). The developers also ensured that the parks were designed to include sustainable landscapes as well as water and energy conservation elements, “such as solar-powered trash cans, smart irrigation systems, and solar lighting,” so that sustainable design practices are being upheld and the amount of maintenance required to upkeep the parks would be small (LA Parks, Accessed October 2022). What followed was 53 parks placed in areas of Los Angeles deemed park-poor zones which resulted in more public park space for community members. Initiatives like 50 Parks are applicable to future public sports infrastructure. Soccer can be adapted to smaller-sized fields, and it will be important to consider the sustainability of synthetic turf and surfaces as the city looks to develop future spaces in the park-poor regions of Los Angeles.

Literature Review

Two aspects of the research question are explored below- the culture of soccer in communities and the potential environmental and physical impacts synthetic grass fields have on the people using them. Synthesizing the theory and scholarly work behind the role of soccer as a cultural tool for community development in the world provides an important understanding of how public soccer spaces can transform the daily lives of communities in Los Angeles. As natural grass fields are increasingly replaced with turf, pollution from synthetic grass might lead to the environmental impacts of the fields on communities. In addition, there are economic implications that the development of turf fields has on Los Angeles, which is important when considering future policy recommendations. Based on previous literature, the physical and environmental risks of synthetic turf fields are no greater than that of grass fields and can present communities with a flexible urban infrastructure that requires minimal maintenance and adapts to climate challenges at the local level.

Importance of Soccer-Specific Fields

The structure of soccer games and the culture that it promotes provides communities with healthy and safe options for youth to be active and engage with others. In New York, Saturday Night Lights (SNL) is a "signature youth development program created by Manhattan District Attorney Cyrus Vance," that aims to provide safe spaces where youth can spend their Saturday nights (U.S. Department of Health and Human Services, 2022). A highlight of this initiative has been the soccer program in East Harlem. Through the use of small-sided synthetic turf fields, the program typically welcomes about 70 youth every Saturday night and maintains an impressive 90% retention rate (U.S. Department of Health and Human Services, 2022). Due to the urban

density of New York, the program mainly functions out of public indoor spaces. However, these public spaces are very common in New York to provide the city's residents with public recreational options with minimal green space and during frigid temperatures (NYC Parks, Accessed November 2022). The point still stands that small-sided soccer spaces can transform communities actively and safely.

The History of Synthetic Turf

Considering that a lot of the public soccer field spaces in Los Angeles are synthetic turf, the environmental and physical impacts explained have real consequences for communities in the city. Synthetic turf was developed in the mid-1960s and gained widespread popularity as a cheaper replacement for grass that requires minimal maintenance and water treatment. While installation is significantly less expensive for natural turfgrass than synthetic turf, “the annual cost for routine maintenance of natural turfgrass (e.g., mowing, irrigation, painting) generally exceeds the cost of synthetic turf maintenance (e.g., grooming, disinfecting, carpet repair)” (Straw et al., 2022). In the 1980’s the second generation of synthetic turf was developed and used sand as infill material (Russo et al., 2022). Following this, third-generation of synthetic turf hit the market in the 1990’s and introduced crumb rubber infill which had the function of “providing shock absorption similar to that of natural grass and of preventing vertical deformation of the surface while maintaining high-quality standards for the ball’s rolling and bouncing” (Russo et al., 2022).

Many environmentalists believe that there are major environmental issues with synthetic turf and crumb rubber which include overheating to as high as 200°F on hot days and toxic exposure (Priesnitz, 2019). In addition, synthetic turf companies have a history of using toxic materials in their products. Companies were reported using “lead paint” to make plastic blades of

grass green to mimic the look of real grass and a finer version of tire mulch called crumb rubber which contains “heavy metals, other chemicals, and sheds dust that can easily get into a person’s mouth, nose, shoes, and clothing” (Priesnitz, 2019). People suggested filling the available space for park development with other surfaces like wood chips, rubber mulch, and sand/pea gravel, but the expense of these infill materials produces barriers for certain regions of the country that use cost-effective rubber mats (Priesnitz, 2019). However, a report from Environment and Human Health, Inc. (EHHI) – a non-profit organization composed of doctors, public health professionals, and policy experts, claim that rubber mats are not safe (Priesnitz, 2019). Rubber mats, which are made from recycled tires and crumb rubber were found to have “11 volatile compounds and nine metals leaching and outgassing from 17 crumb rubber samples” (Environment and Human Health, Inc., 2017). Although rubber mats contain higher volumes of recycled tire and crumb rubber than synthetic turf, it is still important to consider the effects of these materials as they interact with people through synthetic turf surfaces. The Environmental Protection Agency claims that research cannot reach “comprehensive conclusions without the consideration of additional data” when debating the intersection between synthetic turf, pollution, and injury (Priesnitz, 2019). The lapses in research on the topic from organizations as credible as the EPA leaves room to question how accurate claims are that synthetic turf is not beneficial for community spaces. Understanding previous research that explored crumb rubber pollution will be critical for filling these gaps, especially since the synthetic turf industry is cementing itself in Los Angeles.

Exposure Analysis

Crumb Rubber and Infill

Most research on pollution in synthetic turf, albeit limited, is centered around crumb rubber exposure in children and adults. Crumb rubber is used as a "component of many recreational fields", including synthetic turf fields, and makes up to 90% of the field's weight (Schiliro et al., 2013.). The material is mainly recycled from end-of-life vehicle tires and poses many economic benefits because of the large number of recycled vehicle tires (Russo et al., 2022). Due to the unique way that children interact with the environment, they tend to be more susceptible to chemical exposures than adults (Priesnitz, 2019). Traditionally published resources and networks of environmental health experts could not establish the "safety of tire crumb products in use with children or adults present," but insists that the impacts are not any greater than surrounding areas with high pollution (Anderson et al., 2006). The risk of hazard exposure is low since the potential risk comes from direct contact through inhalation or contact (Schiliro et al., 2013). Although children can be sporadic in their interaction with the environment, it is unlikely that they will ingest crumb rubber (Schiliro et al., 2013). On top of this, it has been proven that the gastric acid juices of the digestive system are not powerful enough to "extract the toxic products from the crumb" (Schiliro et al., 2013). In terms of skin abrasions, the same research stated that "a solvent that is more effective than water would be needed to extract toxic compounds in quantity, and an adequate (nonpolar) carrier would be necessary to penetrate the skin and cause significant absorption" (Schiliro et al., 2013). With contention around crumb rubber infill, some communities are "opting for alternative infills, even though most of the alternative infills are more expensive" (Environment and Human Health, Inc., 2017). However, scientists explored other options but returned to crumb rubber. Cork, wood granulate, sand, and

coconut fiber arose as potential solutions that provide fields with a seemingly more organic alternative (Russo et al., 2022). Cork is particularly promising due to its well-established industry in the Mediterranean region and that cork oak forests represent large reserves of biodiversity and ideal forest habitats for animal species at risk (Russo et al., 2022). The same study claimed that there is an initiative to develop synthetic turf fields that require no infill (Russo et al., 2022). However, none of the aforementioned alternatives reach the standards of player performance and safety set by FIFA, soccer's global governing body (Russo et al. 2022). While financial concerns and limited knowledge around other infills currently present crumb rubber as the most feasible financial and performance option for synthetic turf in LA Parks, it will be important to investigate potential alternatives that have fewer environmental concerns.

Types of Toxins

While many interactions with synthetic turf are on the individual level, previous research also considered how crumb rubber interacts with the overall environment. The EPA conducted extensive research on synthetic turf and crumb rubber infill. In their risk assessment of crumb rubber, the EPA tested the bioaccessibility of toxic metals in crumb rubber infill (Environmental Protection Agency, 2019). By testing bioaccessibility, the EPA investigated the fraction of the total amount of a substance that is potentially available for absorption. This was crucial research, as it provides quantitative solutions to the uncertainty of crumb rubber being digested or in contact with open wounds. While the default assumption for bioaccessibility is 100%, "the mean bioaccessible fractions averaged approximately 3% in artificial gastric fluid, and less than 1% in saliva and sweat plus sebum," which complements the recent findings from Schiliro et al.'s study (Environmental Protection Agency, 2019). This information concludes that while crumb rubber

infill can get stuck in shoes, clothes, cars, and many other things, there is little to no risk of toxic exposure.

Particulate matter is a microscopic particle of matter that can be found in many things like air, dust, and vehicle emissions (CDC, Accessed December 2022). Considering that Los Angeles "averages the highest level of vehicular travel per capita, and the worst traffic congestion in America", particulate matter (PM 2.5 and PM 10) is a serious issue (Schrank & Lomax, 2007). Furthermore, urban sprawl in Los Angeles places many communities of color near highways and other pollution sources, and increased particulate matter pollution from synthetic turf fields would put frequent users of the field, particularly children who are more vulnerable, at a greater risk of toxic exposure. One study took samples of crumb rubber from six synthetic turf soccer fields in Torino, analyzed them for numerous pollutants, and compared them to pollution rates in surrounding urban areas throughout the year to consider seasonal weather changes (Schiliro et al., 2013). PM 2.5 and PM 10 were observed to consider the finer particles found in PM 2.5 and the coarse and bigger particles found in PM 10. At the soccer field sampling sites, the measurements were performed at the "top of the penalty area, whereas for urban sampling sites, the measurements were performed at the atmospheric meteorological–control stations" (Schiliro et al., 2013). The top of the penalty area is arguably the best place to take crumb rubber samples since the location of that spot is close to the goal and naturally has many players who are diving and sliding on the ground to block a shot or score a goal. In sum, the conclusion was that "no significant differences were found between PM10 concentrations at the urban site and on the turf football fields both on warm days and on cold days, either with or without playing" (Schiliro et al., 2013). This is in line with the EPA's assessment that "at outdoor fields, lower emissions of several organic chemicals were found with increased age of the synthetic turf field" (Environmental Protection Agency, 2019). Furthermore,

"neither background nor traffic at the field sites influenced PM2.5 concentrations" (Schiliro et al., 2013).

This research paired with the aforementioned need by the EPA for analysis of additional data provides a background for potential research projects in Los Angeles to work from. This is crucial considering that there is minimal research done in Los Angeles on synthetic turf pollutants.

Injury Risk from Synthetic Turf

There is a risk of injury anytime someone is active, especially if they are playing a sport. Soccer is "among the most common for sports-related injuries," so ensuring that the playing surface is safe for players is crucial (U.S. Department of Health and Human Services, 2022). Wendy Priesnitz claims that there is an increased risk of skin abrasions and ankle injuries associated with synthetic turf surfaces (2019). Skin abrasions, or turf burns, are somewhat common in soccer and are notoriously known for the discomfort they cause. However, they are not serious injuries and rarely require more than at-home treatment to heal (Priesnitz, 2019). If synthetic turf surfaces were found to have a justifiable increased risk of injury, certain public policies would need to be quickly implemented to ensure the safety of people using those surfaces. A 2010 study looked to address the effect of synthetic turf soccer surfaces on injury rates since it has not been clearly established, and "the available literature is largely limited to football and soccer data" with the majority of studies being short-term (Dragoo and Braun, 2010). What they found was that "the overall incidence of injury on artificial turf and natural grass did not differ significantly during practice and training" (Dragoo and Braun, 2010). The study used data from the National Collegiate Athletic Association Injury Surveillance System (NCAA ISS) during the 2005 and 2006 seasons and found an increase in head injuries and skin

abrasions for men on synthetic turf (Dragoo and Braun, 2010). However, none of the head injuries were a result of a head-surface collision, and skin abrasions can also occur and be just as painful on grass. Inversely, the study found that the incidence of ankle sprains in women was significantly lower on synthetic turf than on grass (Dragoo and Braun, 2010). The consensus from the majority of studies evaluating the effect of synthetic turf surfaces on soccer injury reveals "no significant differences in overall injury rates when compared with natural grass" (Dragoo and Braun, 2010).

If environmental pollution reflects no significant increase due to synthetic turf and injury rates are also consistent regardless of if the field is grass or synthetic, why is it that synthetic turf is still questioned? A lack of data could be a response. Most studies cite a lack of research on the environmental and physical risks of synthetic turf as a catalyst for their study. However, at this point, it could be that researchers have accepted that synthetic turf has its harms but is not significantly worse than grass. In terms of policy recommendations, it will be important to consider ways to improve public soccer spaces through sustainable synthetic turf models since synthetic turf has the potential to be not as harmful as some may think.

Defining Soccer Fields by Type: Small-Sided Soccer Fields

Los Angeles must prioritize increasing public small-sided soccer fields as the free-spiritedness of the game fosters an inclusive recreational environment, implementation is quick, and the small dimensions of the field turf echo the sustainable blueprint for Los Angeles's 50 parks initiative. Furthermore, the limited players, space, and flexibility of the surface needed, paired with the intensity of the game provides many wonderful benefits for cardiovascular training (Brito et al., 2012). Small-sided soccer fields are used in a more recreational sense since the smaller dimensions of the field mean that fewer people are needed to play a game (between 3

to 5 per team) (Worby, 2009). The culture of small-sided soccer is heavily embraced abroad. In places like England, France, and South Africa, one can find small-sided soccer fields on the streets just as much as they would find basketball courts in America. In South Africa, small-sided soccer in urban regions like Johannesburg suspends the dark history of Apartheid's racially-based segregation (Worby, 2009). Players have the freedom to engage in charismatic self-fashioning, inventing a "fantasy persona" on the field that is larger than the life they live at other times and places in the city (Worby, 2009). This is very particular to the small-sided recreational soccer game. The organized structure of full-field games includes factors like referees, coaching tactics, and less time on the ball which results in fewer opportunities to develop and express a fantasy persona (Worby, 2009). Small-sided soccer is becoming increasingly popular in America, and companies like Urban Soccer Park are inspired by the cultural and global impact of the game by developing models for small-sided infrastructure (Urban Soccer Park, Accessed 2023). Their model incorporates synthetic turf with many cutting-edge and sustainable materials like organic infill and containment barriers for the ball, and the company is hoping to expand its partnerships with the Public Park Departments in major American cities (Urban Soccer Park, Accessed March 2023).

In Los Angeles, the intersection of culture at public soccer fields can be captivating. At places like Glassell Park, it is common to find intense small-sided games happening with locals of all ages whistling and talking while music and the rhythmic bounces of basketballs can be heard in the background. A number of the people interviewed in Pierrette Hondagneu-Sotelo's study about the types of culture displayed in public spaces in Los Angeles shared this sentiment. In particular, one person and his family were interviewed at a public park while they "watched a soccer game and enjoyed music from the adjacent African-American drum circle" (Hondagneu-Sotelo, 2006). This sort of 'adventure', where culture, sport, music, and community

harmoniously intersect is unique to soccer. Seeing that "Americans increasingly identify with soccer as participants, not observers," small-sided soccer fields provide an environment for this 'adventure' to naturally occur (Veseth, 2006). Therefore, an increase in the number of small-sided fields in Los Angeles would tremendously benefit the city.

Small-sided fields are a little smaller than a basketball court and are usually built with a form of containment barriers around them to keep the ball from constantly being kicked far away from the field. They are quicker and cheaper to build and take up significantly less space than full-sized fields. For instance, Glassell Park has a small-sided synthetic turf soccer field that is 88ft x 64ft and is used daily (LA Parks, Accessed November 2022). In consideration of possible environmental pollutants from synthetic turf, small-sided soccer fields require significantly less turf and crumb rubber (turf infill) than a full-sized soccer field. The installation of a full-sized synthetic turf soccer field can cost between $750,000 to $1,000,000, and the cost to develop a small-sided synthetic turf soccer field is between $44,000 – $150,000 with prices varying on field auditions and surface type (Sports Venue Calculator, Accessed October 2022). Since the lifespan of the field is "generally 8 to 10 years," around 50% of total construction costs should be factored in to make sure the fields are in the best condition (Straw et al., 2022). The durability and economic benefits of small-sided synthetic turf soccer fields for Los Angeles communities present a feasible option for sustainable field development in park-poor urban areas that are not as easily maintainable with grass.

Synthetic Turf at the Community Level

Most of the research on the benefits and tradeoffs of synthetic turf was conducted for high-level sports performance. While this research has merit, there is essentially no community-level literature or considerations in the findings of these studies. A white paper with

the hope of providing a blueprint for reimagining sustainable community sports fields of the future provides some insight (Straw et al., 2022). Their suggestions center on a "multi-stakeholder dialogue about issues related to improving the social, economic, and environmental sustainability of community-level sports fields" (Straw et al., 2022). In doing so, scientists and community organizers will have a framework to work together on creating future public sports fields, while learning from each other. Furthermore, scientists with "diverse research backgrounds, yet with mutual research interests, collaborate to address and promote sustainable development" (Straw et al., 2022). If possible, it could also be helpful to prioritize scientists in collaboration with community organizations within Los Angeles who have a more personal relationship through lived experiences with the city. A major benefit to this, considering the previous research, is that important dialogues around the safeness and practicality of synthetic turf fields will be paired with a community understanding of how these spaces would uniquely serve each community.

Focusing on practicality for community development, "the primary advantage of artificial turf over natural turfgrass is durability, so its biggest return on investment is likely the potential to schedule more events year-round" (Straw et al., 2022). Having a field that can withstand multiple community events is crucial to the development of caring environments for local youth. Soccer fields are capable of doing more for communities than just playing the sport and having a field that can withstand multiple events and still be accessible enough for soccer players should be a standard. Similar to Priesnitz, Straw et al. recommend that people should reduce play during excessive heat. However, it seems like it will be difficult to regulate field access and use during hot days across all synthetic turf soccer fields.

Missing Research

As discussed, there is minimal research on synthetic turf. The available research is older and there is not any clear research on Los Angeles specifically. Since the city decided to change most of its grass fields to synthetic turf, there is limited research in Los Angeles specifically on the benefits and tradeoffs of synthetic turf soccer fields. Through interviews, mapping, and developing a framework for future policy, this study will look to provide a solution that encourages collaboration between experts in various fields to understand the best ways to live with and use synthetic turf in LA Parks.

Methodology

For this project, the primary methodology was 19 semi-structured interviews and a 31-person survey (see Appendix A for questions). This was paired with ArcGIS mapping which displayed heat anomalies recorded from synthetic turf and grass soccer surfaces. The purpose of the mapping was to build off previous literature and opinions from the survey and interviews in this study which voiced concerns about synthetic turf surfaces overheating.

Interview Process

To answer the question of how local governments can understand the benefits and tradeoffs of synthetic turf soccer fields in Los Angeles, stakeholders working on these issues as well as the people affected by the issue were interviewed. Table 1 below displays the list of interviewed stakeholders.

Person Interviewed	Affiliation
Staff Member 1	LA Parks- Yucca Community Center
Staff Member 2	LA Parks- Glassell Park
Staff Member 3	LA Parks- Rosecrans Recreation Center
Journalist	Northeast LA Community member
Parent 1	South Pasadena Community member
Parent 2	South Pasadena Community Member
Parent 3	LA Community Member
Coach 1	Assistant college soccer coach and local high school soccer coach in Los Angeles.
Coach 2	Head college soccer coach and director of coaching for a soccer club in Los Angeles.
Coach 3	Assistant college soccer coach and local club soccer coach.
Coach 4	Soccer coach at a Los Angeles Private School
Coach 5	Former college soccer player and coach living in Europe.
LAUSD Athletic Director 1	LAUSD School Athletic Director
Athletic Trainer 1	College Athletic Trainer
Athletic Trainer 2	College Athletic Trainer
Professor 1	College Biology Professor in Los Angeles
Professor 2	College Soil and Agriculture Professor in Texas
Organization Representative 1	StreetSoccerUSA
Organization Representative 2	Safe Healthy Playing Fields Inc.

Table 1: List of interviewed stakeholders.

The data from these interviews were supplemented by a survey of 31 Men's and Women's college soccer players at Occidental College. The survey data displays the general

opinions of college players about synthetic turf and grass surfaces which were effective in collecting general opinions around the topic from a crucial stakeholder (see Appendix B for survey link and questions).

Another important component of the research methodology was analyzing how synthetic turf soccer fields in Los Angeles could contribute to an increased number of 'heat islands.' One of the biggest concerns among community members and soccer coaches was increased levels of heat on synthetic turf. To better display these concerns and investigate trends across grass and synthetic turf soccer fields, GIS mapping was used to analyze heat exposure coming from soccer fields. Using GIS allowed for visualization of the heat exposure from selected soccer fields. Table 2 displays the selected parks and the reason for selection.

Field Name	Field Type	Surface Type	Affiliation
Glassell Park	Small-sided	Synthetic Turf	LA Parks
Rosecrans Recreation Center	Full-sized	Synthetic Turf	LA Parks
Yucca Community Center	Small-sided	Synthetic Turf	LA Parks
Field of Dreams Park	Full-sized	Grass	LA Parks
John Ferraro Athletic Field	Full-sized Field Complex	Synthetic Turf and Grass	LA Parks
Great Park Sports Complex	Full-sized Field Complex	Synthetic Turf and Grass	City of Irvine
Jack Kemp Stadium	Full-sized	Synthetic Turf	Occidental College
Upper Campus Soccer Field	Full-sized	Grass	Occidental College
North Field	Full-sized	Synthetic Turf	California Institute of Technology
Cathedral HS	Full-sized	Synthetic Turf	Private High School
Eagle Rock HS	Full-sized	Grass	LAUSD Public School

Table 2: List of selected soccer fields for heat analysis.

Focusing on LA Parks, the public soccer fields selected were Glassell Park, Rosecrans Recreation Center, John Ferraro Fields, Yucca Community Center, and Field of Dreams Park. They were chosen due to the variation in synthetic turf field size, hours of operation, neighborhood location, and communities they serve. Glassell Park is a predominantly Latinx neighborhood in Northeast Los Angeles that also has a high Filipino immigrant population, and borders Pasadena and Glendale. Rosecrans Recreation Center is located in between Gardena, a predominantly Latinx community, and Compton, a historically black community that is now

predominantly Latinx. John Ferraro Fields is located in Griffith Park, with much of the park making up the zoning and its surrounding neighborhood being predominantly white. Yucca Community Center is located in Hollywood, a block away from Hollywood Boulevard, one of the busiest and most densely populated areas of Los Angeles. Field of Dreams Park is located in San Pedro, a suburban area of Los Angeles. For further information, Table 3 contains the racial demographics of each neighborhood.

Racial Demographics	% of race for Hollywood	% of race for Glassell Park	% of race for Gardena	% of race for Griffith Park	% of race for San Pedro
Hispanic or Latino	36%	54%	40%	21%	50%
White	44%	23%	26%	59%	33%
Asian	9%	17%	21%	13%	7%
Two or more races	4%	4%	9%	3%	6%
African American	7%	2%	3%	3%	3%
Other race	1%	1%	1%	>1%	>1%
Hawaiian or other Pacific Islander	>1%	>1%	1%	>1%	>1%
American Indian or Alaska native	>1%	>1%	>1%	>1%	>1%

Table 3: racial demographics of each neighborhood (US Census Bureau)

Methodology Limitations

Due to the lack of data on synthetic turf in Los Angeles, there are limitations to the methodology chosen. Having to develop data through semi-structured interviews, with a time constraint, will inevitably mean that certain opinions might be left out. On top of this, the lack of

previous data extends to topics like short and long-term effects of injury rates and chemical exposure, as it relates to synthetic turf in LA Parks. While this research aims to bridge this gap, it must also provide a framework for future research to delve deeper into topics that could not be done in this study.

It was difficult to get in contact with people. Many interviews that I hoped to have never occurred because people either did not respond or refused to speak about this topic. Notably, public parks with grass soccer fields refused to speak with me. However, the data gathered from LA Parks staff members and other community members encompassed experiences with public grass soccer fields and was useful for the results. Park managers and public school officials were also difficult to reach. As many staff members explained, the pandemic greatly impacted the workforce in public parks. Furthermore, the bureaucratic structure of LA Parks made gathering information across sectors of park staff challenging. Oftentimes, calls and inquiries would be directed to another person, who would then direct them to someone else, who would then direct them to the first person, and so on.

Data and Findings

In interviews with experts on soccer, field sustainability, land use, community organizing, and Los Angeles public policy, small-sided synthetic turf soccer fields are a plausible solution for LA Parks to address drought and maintenance issues while providing urban communities with durable multi-purpose surfaces. The interview subjects suggested that soccer is a catalyst for community development with its global culture encouraging physical activity and community engagement. While synthetic turf might be a great option for LA's public fields, most subjects

would ideally push for a well-maintained grass surface if that option was feasible. There are still a lot of concerns around synthetic turf with people lobbying for stronger regulations and geospatial heat indexes displaying increased levels of heat on large synthetic turf surfaces. However, small-sided synthetic turf fields not only have a lower heat index but also take up significantly less space, compared to full-sized synthetic turf soccer fields. Considering the environmental and political roadblocks to achieving well-maintained grass fields across Los Angeles, there are strategies to look towards using synthetic turf in a sustainable and environmentally conscious way.

Opinions from the Coaching Perspective

Generally, the interviewed soccer coaches believed that synthetic turf fields are beneficial for soccer in public parks at the youth and recreational levels because they provide young children and recreational facilities with a year-round reliable surface. All soccer coaches spoke about frequently finding poorly maintained grass fields in public parks and synthetic turf provides a plausible solution to grass field maintenance.

The benefits of small-sided soccer in Los Angeles

Coach 1 grew up in Los Angeles and explained that playing small-sided soccer has always been a popular form of the game in the city. However, the public grass fields he used would oftentimes be an obstacle as they usually had “dirt and holes in the middle of the field” which convinced him that synthetic turf fields are better for public parks. In Europe, small-sided synthetic turf soccer fields are “as common as basketball courts in America,” according to Coach 5 who recently moved to Europe from Los Angeles. Coach 5 also believed that the small-sided infrastructure in Europe would be used constantly in Los Angeles but must be synthetic turf to

avoid maintenance issues. Coach 2 also believed that synthetic turf was perfect for small-sided soccer fields and the addition of more durable small-sided fields in Los Angeles has the power to make the city the "mecca of US soccer." This was affirmed by Coach 3 who stated that small-sided synthetic turf fields are very beneficial for facilitating a love for the sport at a recreational level since the nature of the game is faster-paced and more stimulating. While all coaches are aware of the potential negative environmental impacts of synthetic turf, it is a tradeoff that they must deal with in their line of work. However, when injuries were discussed, all of the coaches spoke very strongly against synthetic turf.

Injuries on Synthetic Turf

Coach 1 and Coach 4 spoke about serious injuries (torn ACL and damaged knee) that they sustained on synthetic turf and believe were made worse by the surface. While both of these injuries occurred on older generations of synthetic turf surfaces that did not have the current safety measures such as shock resistance, all coaches believed that the new generation of synthetic turf still makes aspects of the game like changing physical direction challenging. Coach 2 discussed how things like "lateral body movements" and "direction change" are still very difficult on synthetic turf and he continues to observe serious ankle and knee injuries on the surface. Furthermore, Coach 1 stated that synthetic turf should not be used once children reach a higher level of competition like high school and college because the physical demand is so high. In light of this, I spoke with Coach 4, a coach that works at a private school in Los Angeles that owns a grass field. While he spoke highly of the grass, Coach 4 admitted that the maintenance of the field "must be expensive" because of how often it is watered and cut. Although Coach 4 is not opposed to synthetic turf surfaces, he stated that "we don't realize the impact of injuries at a young age with (synthetic) turf" and held that whenever a grass field can be properly maintained,

it is the best surface. Another aspect of injuries that all coaches spoke about was skin abrasions or 'turf burns'. Coach 4 explained how he notices a visible increase in the frequency and severity of skin abrasions on synthetic turf surfaces compared to grass surfaces. He believes "synthetic turf cuts through the skin deeper than grass" which makes turf burns a harder injury to manage.

Heat Control on Synthetic Turf

All interviewed soccer coaches heavily scrutinized the protocol around playing on synthetic turf in extremely hot weather. Many coaches believed that the "rubbery surface" places players at a greater risk of infection if they get a skin abrasion. Furthermore, the feeling of playing on synthetic turf is very hot on a player's feet with Coach 1 claiming that "the temperature on turf is way higher than it is on a non-turf surface 20 feet away." Coach 3 stated that "synthetic turf reflects the heat and it becomes hard for young athletes… There should be a rule about the heat and turf, especially for the younger kids." While the coaches were aware of the environmental concerns of synthetic turf, including claims of long-term exposure leading to cancer, synthetic turf fields are impossible to avoid. Because of this, many of the coaches seemed to accept the potential environmental risks of the surface.

Opinions From the Community Perspective

Speaking with community members provided very unique and diverse insights into soccer surfaces. I spoke with a variety of people including parents of children who play in local soccer leagues that use public park facilities, college soccer players that use public soccer facilities to train in the off-season, and people who consistently play pick-up soccer at public parks. There was not a singular consistent opinion among community members. There were concerns about toxins and carcinogens coming from synthetic turf, as well as concerns around

the risk of poor grass field maintenance. Nonetheless, the diversity in responses proved that outside of academia, within the communities that are most reliant on these spaces, there remains a lot of uncertainty around whether grass or synthetic turf is the better surface.

A Public Opinion on Grass

Parent 1, whose child plays in South Pasadena's local youth leagues, was strongly in favor of grass and firmly believed that "synthetic turf in public parks is a disaster." However, she also believed that grass can be harmful due to extensive pesticides but is still better than "rolling out all that plastic." Following January's unexpected heavy rain in Southern California, the grass surface that Parent 1's child plays on seems to be more dirt than grass. Despite this, she still prefered grass, natural and pesticide free, over synthetic turf or pesticide-heavy grass because it allegedly protects the surrounding wildlife and people using the field. While California's usual dryness can also pose challenges to field maintenance, Parent 1 believed that a solution could be buffalo grass, a California native grass that is more drought and heat-resistant than other types of grass. While buffalo grass has drawbacks like easily developing weeds, it avoids issues like crumb rubber infill. Parent 2 who has two children, one that plays college soccer and another that plays high school soccer, voiced her concerns about the smell of turf infill on hot days and how easily it gets in clothes, hair, and shoes.

The Emotional Connection of Grass With Soccer

Parent 1 believed that when people play on synthetic turf they "lose some of the experience of playing soccer." For her, the smell of grass adds to the element of the sport and she would do her best to "get out of a situation where my son plays on plastic." This was not the first time someone mentioned this intersection between the experience of playing soccer and grass. It

seemed like many community members, whether for or against synthetic turf, agreed that there is an aspect of the game that is lost when it is not played on a grass surface. However, she and other community members that were in favor of grass were still committed to watching their kids play and supporting them even if it was on synthetic turf.

A Public Opinion on Synthetic Turf

While grass provides an added layer of emotional connection to soccer, many community members spoke out against gopher holes in grass fields caused by a lack of maintenance. The Journalist explained that he "tweaked his back" in a gopher hole, and, while synthetic turf surfaces are "still harder than grass," it solves the gopher hole issue which was one of the main maintenance problems with grass fields in LA Parks. When asked about the quality of current synthetic turf fields, this same community member explained that the new generation of synthetic turf is great because "it feels like there is no infill." Parent 3, whose child plays in a local Pasadena soccer league, expanded on this comment by comparing the new generation of synthetic turf to grass: "If the goal of synthetic turf is to replicate grass, then it seems like they are moving in this direction." Furthermore, Parent 3 explained that he loves synthetic turf because it ensures that his child can play year-round on a good-quality field instead of one with a lot of dirt and holes. Many community members also voiced concerns over excessive pesticide use on grass fields that they believe pose a threat to themselves and the surrounding wildlife. While community members provided great insight and opinions about the quality of soccer fields at their public park, it was just as important to speak with park staff members and public school officials that assist in the development of public soccer spaces and manage the year-round use of soccer fields.

Opinions from the Public Sector

In speaking with public sector staff members from LA Parks and LAUSD, the consensus was they supported both grass and synthetic turf fields. However, the easier maintenance, multi-use ability, and foot-traffic durability of synthetic turf led many of them to believe that synthetic turf fields are good options for public spaces.

Maintenance Challenges in Public Parks

Considering that maintenance seems to be a major issue in the debate between synthetic turf and grass surfaces, it is important to understand how public park officials deal with this aspect of management. Staff Member 1 stated that having a synthetic turf field "helps with the shortage" since minimal surface treatment is required. Seeing that surface treatment varies by park, Staff Member 2, who works at Rosecrans Recreation Center, explained that they have a sweeping machine that cleans the field's surface and crumb rubber infill twice a week to ensure that it is the best quality for the public use. Although rain in California is scarce, Staff Member 2 explained that synthetic turf requires minimal to no maintenance after rainstorms since the material is water-resistant. While Glassell Park's fields are open to all community members, Yucca Community Center's field is only open to children and teenagers and Rosecrans Recreation Center's field is by permit only. Staff Member 1's reasoning for Yucca Community Center not allowing adults on the field is that it "reduces the wear and tear" on the turf. Glassell Park has both a small-sided and a full-sized synthetic turf field that is open to all community members and is always being used.

Synthetic Turf's Multi-Use Ability

All interviewed LA Parks staff members spoke highly of the successful programming that occurs on their synthetic turf soccer fields. Outside of consistent soccer matches, their fields are durable enough to be used for other events. Specifically, Yucca Community Center and Rosecrans Recreation Center use their fields for special events like an annual easter festival where they set up a bouncy castle on the synthetic turf and monthly programming.

The Challenges of Grass Fields in LAUSD

LAUSD is the second-largest public school district in the nation which supports many low-income communities of color and suffers from underfunding. For instance, Athletic Director 1's high school does not have maintenance resources like a consistent groundskeeper and instead relies on the school's football coach to cut the field. Understandably, the football coach only cuts the field when his sport is in season. This leads to similar maintenance issues at public parks, like gopher holes and dead grass, occurring on the high school field. Due to these shortcomings, the field is not open to the public and remains closed outside of school-sanctioned sports. Athletic Director 1 explained that "most fields in our district are grass and poorly maintained." However, the school's athletics department is expected to receive a $10 million grant that Athletic Director 1 is hoping to use to update the grass field to synthetic turf which would allow for public use. A new synthetic turf field could present previously mentioned issues around excessive heat or chemical exposure, but Athletic Director 1 believed that the maintenance benefits of the field heavily outweigh any of these risks. While the public use aspect is contingent on district approval, Athletic Director 1 is hopeful a new synthetic turf field would allow the space to be open to the public.

Opinions from National Organizations

Many national organizations advocate for green spaces and sports. The two organizations interviewed in this study approached the debate around synthetic turf and grass surfaces from completely different sides of the spectrum and provide an interesting debate to consider.

Basketball Courts as Public Soccer Spaces in Los Angeles

StreetSoccerUSA is a nationwide company that aims to "challenge the privatized pay-to-play model by providing children in extremely marginalized areas of densely populated cities with structured soccer and life lessons." Since the company functions in urban areas with minimal access to large grass soccer fields, its business model centers on small-sided games and mainly relies on basketball courts and synthetic turf fields for its programs. While concrete has not been discussed in this research, StreetsoccerUSA prioritizes features of accessibility. Organization Representative 1, a Los Angeles staff member, explained that the abundance of basketball courts in areas like West Adams and Watts paired with how easy it is to "activate" a basketball court into a soccer field makes concrete a useful surface. Since public soccer spaces are scarce, StreetSoccerUSA will temporarily turn spaces like basketball courts into soccer fields by adding small pop-up goals to each side of the court. As Organization Representative 1 explained, this "replicates the street soccer models" made famous in Europe and South America for creating some of the best professional players by allowing them to freely express themselves. Street soccer is an art that has deeply rooted soccer in urban culture internationally.

Street Soccer and Synthetic Turf in Los Angeles

When synthetic turf surfaces are available, StreetSoccerUSA relies on them. Organization Representative 1 explained that it is not feasible for them to find grass surfaces in the areas of

Los Angeles they work in. Low-income areas are often park poor and lack grass soccer fields due to a variety of factors, including limited funding, land availability, and systemic inequalities. In many cases, these areas receive less funding for park and recreational facilities compared to more affluent neighborhoods, resulting in a lack of resources for developing and maintaining sports fields. If a grass area was found, Organization Representative 1 stated that it is "usually not ideal for playing and has a lot of holes." Furthermore, "there is always an issue of limited space and competition so the city tends to regulate its use through permits." He believed that if a synthetic turf field was placed in Inglewood to serve low-income children, many surrounding wealthier neighborhoods like Westchester will also be competing for the space. As a result, that field can quickly turn from a public field to privatized, permit-only access. When asked about small-sided synthetic turf fields, Organization Representative 1 explained that their company heavily relies on them when they are available. However, he also stated that if these surfaces are not properly regulated then they are subject to vandalism. Nonetheless, he believed that outside of activating basketball courts, synthetic turf fields are the most feasible soccer-specific option for public parks in low-income urban areas.

SHPF and Lobbying Against Synthetic Turf

In contrast to StreetSoccerUSA, Safe Healthy Playing Fields Inc. (SHPF) is a non-profit organization dedicated to promoting the use of safe, non-toxic playing fields and recreational spaces. The organization advocates for the use of natural, organic turf management and provides information and resources to schools, municipalities, and other organizations to help them transition to safer, more sustainable turf management practices. Organization Representative 2, one of SHPF's board members, discussed several issues related to synthetic turf as well as congressional initiatives the organization is supporting to heavily regulate synthetic turf use. The

organization had some success in getting government regulation for synthetic turf use, such as the ban of PFAS in all consumer products in Maine, the signing of carpet EPR into law in New York, and the review of PFAS in synthetic turf by the California Department of Toxic Substance Control. Furthermore, Organization Representative 2 explained that SHPF successfully advocated placing moratoriums around synthetic turf in some cities, provided testimony to committees and commissions, and met with federal legislators. Organization Representative 2 explained that prolonged exposure to PFAS is linked to cancer and liver damage among other things, which supports current regulations around the chemical. However, there are still challenges in lobbying and organizing against synthetic turf, including educating stakeholders, limited resources and time, being out-funded by industry lobbyists, and battling what the company calls industry-created myths.

Areas of Successful Grass Use

SHPF uses research related to climate change and local news reports to document impacts on the environment and public health. There are examples of areas that have successfully transitioned to organically managed natural grass playing fields, such as Irvine, California and Martha's Vineyard, Massachusetts. Organization Representative 2 discussed areas that could use the most work in transitioning away from synthetic turf surfaces and highlighted states like Texas, Louisiana, California, Nevada, Pennsylvania, and Arizona as the most worrisome. For instance, Nevada's Clark County Unified School District, located in the Las Vegas area, "recently spent $60M on 29 synthetic fields and plans to spend an additional $300,000,000 over the next six years on an additional 39 fields." As a part of this deal, the school district will receive around $30,000,000 through a rebate program with the Southern Nevada Water Authority (Wotton-Greener, Accessed March 2023). While drought and climate change

present a real problem to the country, SHPF believes there are environmentally sustainable models for maintaining grass fields.

Sustainable Models for Grass

While California Senate Bills like SB 414 and SB 499 are still under consideration, Organization Representative 2 highlighted Irvine as a good example of properly managed natural grass fields. In terms of environmentally sustainable models for maintaining grass fields in public parks, Irvine invested in properly trained turf managers who can address the needs for soil testing, proper installation, and maintenance. From this, Organization Representative 2 that properly installed and maintained natural grass fields can last up to 30 years and are more cost-effective. While these initiatives could improve the accessibility of grass fields, how can equity in opportunity and practicality be ensured?

Finding Equity with Grass Fields

Equity is an important consideration in the context of synthetic turf and natural grass playing fields. Organization Representative 2 explained that there are often disparities in who is impacted by the environmental and health risks associated with synthetic turf, putting low-income communities of color at a greater risk. However, SHPF believes that every community can have access to well-maintained grass fields. To address these equity issues, Organization Representative 2 stressed the importance of advocating for policies and initiatives that prioritize safe and sustainable natural grass playing fields, particularly in low-income communities and communities of color. This includes providing educational resources for the installation and maintenance of natural grass fields, as well as supporting outreach efforts to raise awareness about the health and environmental risks associated with synthetic turf. Organization

Representative 2 briefly discussed community engagement and explained that there are initiatives that directly engage with community needs that SHPF supports.

Synthetic Turf Fields as "Heat Islands"

Considering the previously mentioned concerns around extreme heat, these maps display the heat indexes of different soccer surfaces across Los Angeles. The GIS data display areas in red as having a high heat anomaly index which is also considered 'heat islands.' For instance, Figure 1 displays Occidental College and Eagle Rock High School. The red index is coming from Occidental College's synthetic turf field at Jack Kemp Stadium. Comparatively, Eagle Rock High School's grass field has a low heat index and is only 1.3 miles away. Furthermore, Occidental College's softball field, baseball field, and upper campus soccer field are all grass and have a low heat index.

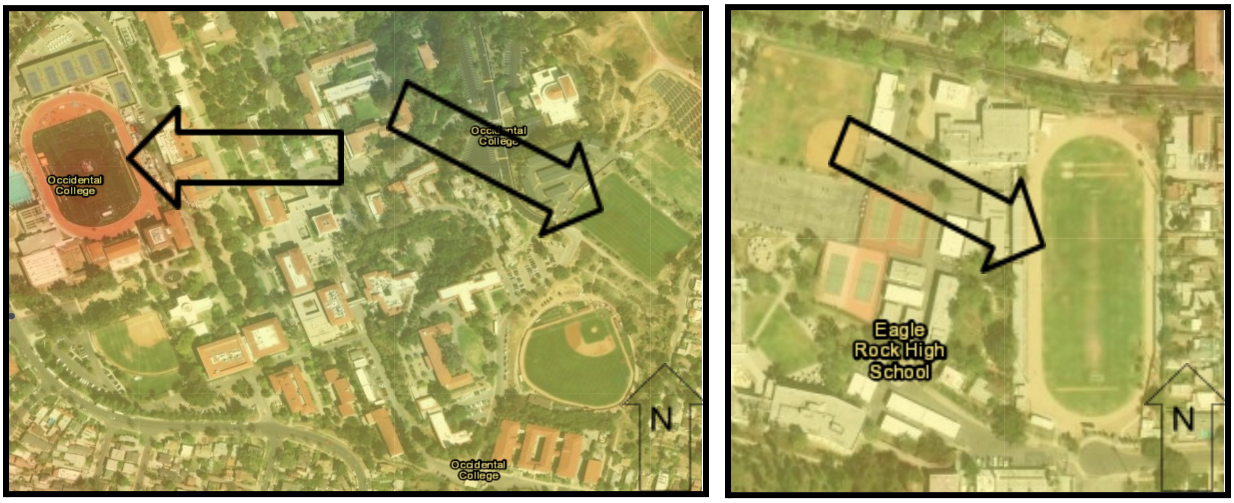
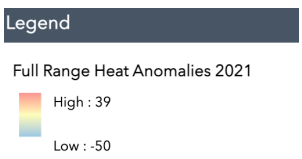


Figure 1: Heat anomaly index between Occidental College's synthetic turf field (left) and Eagle Rock High School's grass field (right).



This trend was consistent across many other schools with synthetic turf fields in Los Angeles. Figure 2 displays Cathedral High School which is located between the Dodgers Stadium and Los Angeles State Historical Park. Although both neighboring grass spaces are significantly bigger than the synthetic turf field, neither has a high heat anomaly. It does seem like there are areas of infrastructure surrounding the Dodgers stadium that attract heat as well which could contribute to the heat exposure from Cathedral High School's field.

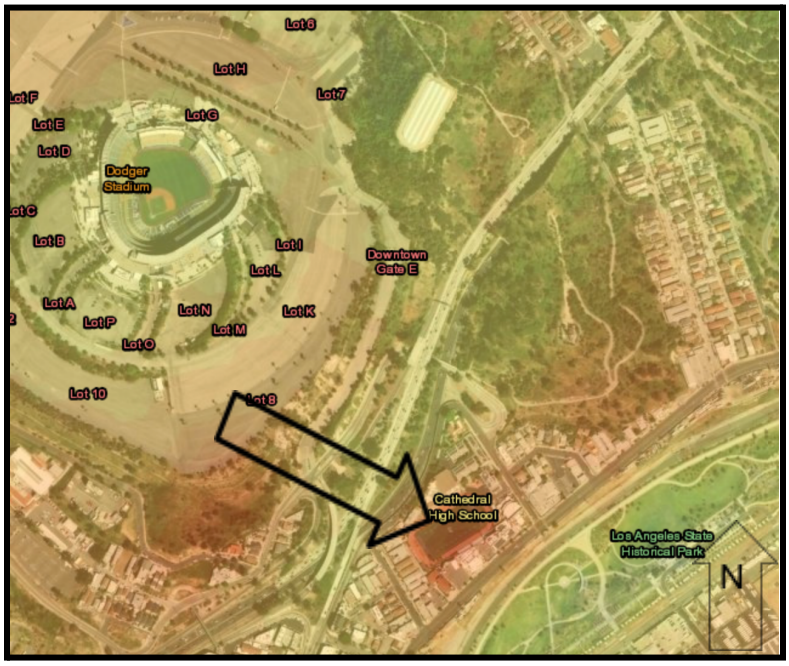
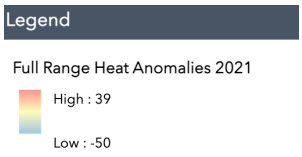


Figure 2: Heat anomaly index of the Cathedral High School synthetic turf field.



It is important to consider that most of these synthetic turf fields have running tracks around them which are also notoriously known for getting extremely hot on warm days. Could this be contributing to the heat anomaly? Potentially. However, Figure 3 displays Caltech's synthetic turf field which is not surrounded by a track and still has a high heat anomaly.

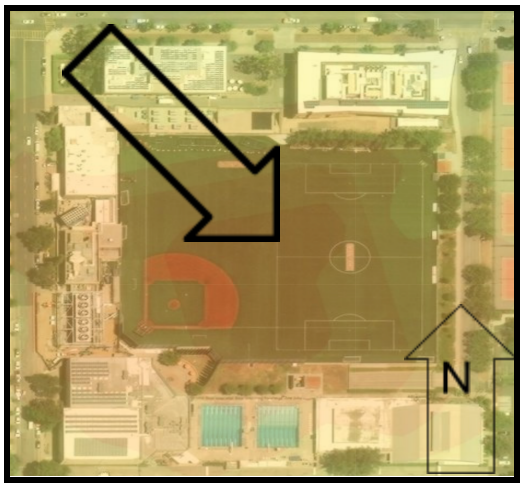
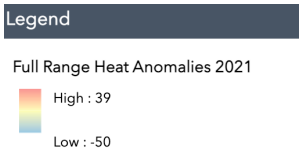


Figure 3: Heat anomaly index of Caltech's synthetic turf soccer and baseball field without a running track.



Variation in Public Parks

In terms of public parks, the trends were similar but provided some variation. Places like John Ferraro Athletic Fields and Great Park Sports Complex, which both have multiple synthetic turf soccer fields, had high heat anomalies. Both complexes displayed their synthetic turf fields as containing a significantly higher heat index than their neighboring grass fields.

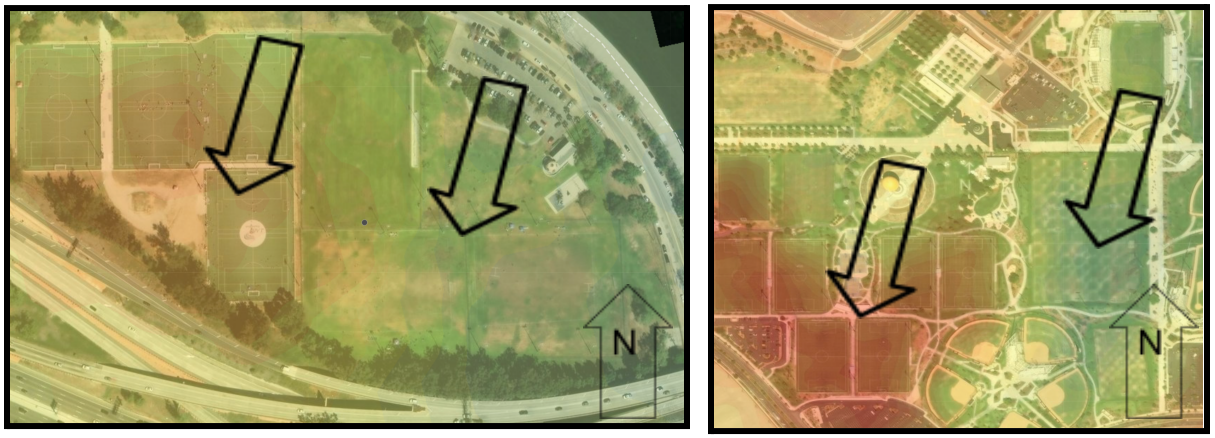
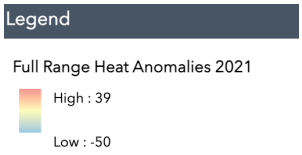
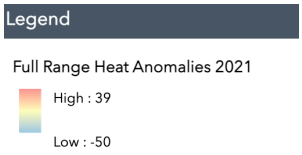


Figure 4: Heat anomaly index between neighboring synthetic turf and grass soccer fields at John Ferraro Athletic Fields (left) in Los Angeles, CA, and Great Park Sports Complex (right) in Irvine, CA.



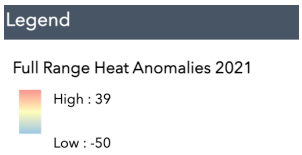
Furthermore, single grass fields like the Field of Dreams in San Pedro have a low rating. Surprisingly, Rosecrans Recreation Center, which has a full-sized synthetic turf field, has a low heat anomaly. While this could be an outlier, Glassell Park's synthetic turf field provides interesting data.

Figure 5: Heat anomaly index of Field of Dreams park in San Pedro, CA and Rosecrans Recreation Center in Gardena, CA.



The heat anomaly index data is from 2021 and at this time, Glassell Park only had a small-sided synthetic turf field as their new full-sized soccer field was still a grass area. As Figure 5 displays, the heat anomaly on the small-sided field was significantly lower than on full-sized synthetic turf fields.

Figure 6: Heat anomaly index of Glassell Park's small-sided synthetic turf field.



On top of this, the heat anomaly on Yucca Community Center's small-sided field was low. With this in mind, small-sided synthetic turf fields seem to indicate lower levels of heat anomaly compared to full-sized synthetic turf fields and could be important when thinking about policy reform around synthetic turf.

Opinions from Academia

Considering the literature around synthetic turf, it was important to discuss this topic with scholars whose work informed this study, as well as those who have an interdisciplinary background that connects their professional experiences to synthetic turf. Professor 1, a college professor in Los Angeles who specializes in spatial ecology and enrolled her children in club soccer, discussed surface management issues in Los Angeles. In line with what the park managers discussed, Professor 1 believed synthetic turf is "far easier to manage" than grass for park maintenance staff, but was concerned about how hot the surface can get since "it feels like

your feet are melting." Professor 1 questioned "on multiple occasions" whether it is safe for her children to play on synthetic turf. While she believed synthetic turf might have a minor impact on the surrounding ecology, Professor 1 admitted there are difficulties around balancing her children's love for soccer with the hazards that come with toxin exposure from synthetic turf. This sentiment was shared among parents and coaches–both those in favor of and against synthetic turf. Furthermore, Professor 1 was equally as concerned about the safety of her children and the surrounding ecology on grass surfaces that are potentially hazardous due to harmful chemicals like "rodenticides." While she was "torn" about which surface was better for the environment and her children, Professor 1 is working to understand the tradeoffs behind having one surface over the other. In doing so, she "leans more in favor of synthetic turf" because of the environmental impacts of drought and excessive water and pesticide use associated with grass soccer fields which can be "just as harmful" as the concerns around synthetic turf.

Importance of Maintenance for Synthetic Turf

New forms of synthetic turf infill are being discussed by scholars in the field, including Professor 2, a professor from Texas who specializes in soil, grass, and crop sciences. Professor 2 mentioned coconut and walnut husks but warned against bacteria that can develop from these products. Professor 2 briefly discussed Nike Grind, which is Nike's initiative to recycle old shoes into new insoles, synthetic turf infill, and more. However, Professor 2 stated that there is minimal injury data for youth regarding Nike's infill project, so safety cannot be guaranteed. While infill can change, maintenance issues still arise. According to Professor 2, one significant maintenance challenge is foreign objects that get stuck in the infill, such as "gum, mouth guards, and pieces of metal that can fall off a player's pad if the field is being used for football or lacrosse." Professor 2 noted that "the synthetic turf industry promotes their product as maintenance free but that is not

the case." If synthetic turf wants to become more sustainable and environmentally friendly, then there needs to be an understanding that proper maintenance is key. It is true that significantly less maintenance than grass fields is required, but there should still be standards. When asked about policies that might better inform stakeholders about the importance of maintaining turf, Professor 2 admitted that there is not much out there. However, he stressed the importance of developing maintenance policies with the emergence of rebate programs incentivizing people to install synthetic turf like the previously mentioned initiative in Clark County and another one in Austin, Texas.

Turfgrass Hybrids and Technology

If there is a push for synthetic turf surfaces to be banned in some regions of the country, then how can soccer surfaces be improved? Professor 2 discussed hybrid methods of grass and synthetic turf, some of which "are being considered by FIFA" for the 2026 World Cup in North America. However, Professor 2 held that these hybrids are not financially feasible for most public parks. Considering grass, there is a lot of new technology like soil and moisture sensors, as well as drones that can measure plant health and normalized difference vegetation index (NDVI) to help make "data-driven decisions about grass health and maintenance." However, like hybrid turf models, Professor 2 believed that there is a financial equity issue with accessing these technologies which does not always make them feasible in the public sector. In terms of local grass models, Professor 2 explained that a big issue with some native soil grass fields in public parks is drainage. Many native types of grass need "subsurface drainage within the native soil field to help remove water." This is particularly important when thinking about the amount of foot traffic on soccer fields. Professor 2 alluded to previous studies which show that "wet grass fields produce more divots and maintenance issues with increased foot traffic." While Los

Angeles is usually dry, the amount of foot traffic on soccer fields is significant and presents similar issues to the ones Professor 2 mentioned.

Injury Observations from Athletic Trainers

Two athletic trainers at a college in Los Angeles spoke about their experiences dealing with injuries on synthetic turf and grass surfaces. Athletic Trainer 1 observed the elevated risk that a synthetic turf field could present to athletes in comparison to a grass field and referred to recent studies which display that:

> "Athletes have a 32% higher risk of a non-contact knee injury and 69% higher rate of a foot/ankle injury on turf compared to a grass field. High degrees of force and rotation are applied to the playing field by athletes. The grass will ultimately give way, which frequently causes the cleat to loosen before reaching an unsafe load."

However, Athletic Trainer 2 did not see a greater risk of injury on synthetic turf compared to grass, discussing how poorly maintained grass poses "just as much risk as synthetic turf." This has been a consistent response across groups and was also affirmed by Athletic Trainer 1.

The Intersection of Maintenance and Injuries

Both athletic trainers cited poorly maintained synthetic turf and grass surfaces as the primary contributor to surface-related injuries. However, even on a well-maintained synthetic turf field, like the one at the trainer's college, Athletic Trainer 1 explained that "we had a few ACL, ankle sprains, MCL sprains, and achilles tendon strains due to the turf. As an athlete, injuries are inevitable regardless of the playing surface but I do see an increased rate of injuries

due to synthetic turf fields." While athletic trainers might not get explicit surface-specific training, Athletic Trainer 2 stated that they do learn about the potential injuries that may occur with poorly maintained surfaces and synthetic turf. One injury that consistently occurs in soccer, regardless of the surface, is skin abrasions or 'turf burns'. Some parents and coaches believed that an abrasion on a synthetic turf surface is worse than one on a grass field, but both athletic trainers stated that "treatment is the same." While infection rates could differ, neither trainer discussed synthetic turf or grass fields having an increased risk of infection due to crumb rubber or pesticide exposure.

Survey Results

Injuries in the College Game

Out of the 31 surveyed Occidental College Men's and Women's Varsity Soccer players, all of them experienced a skin abrasion on a synthetic turf soccer field. Furthermore, many respondents explained that they had severe injuries due to a synthetic turf surface like a hyperextended knee, torn ACL, partially torn MCL, and sprained ankle. Before the newly installed synthetic turf field in January 2022, Occidental College was notoriously known for having one of the worst-maintained synthetic turf fields in their conference, and all respondents that experienced the field were dissatisfied with the surface. Considering this, Figure 7 displays the approval rating of the previously mentioned newly installed synthetic turf field.

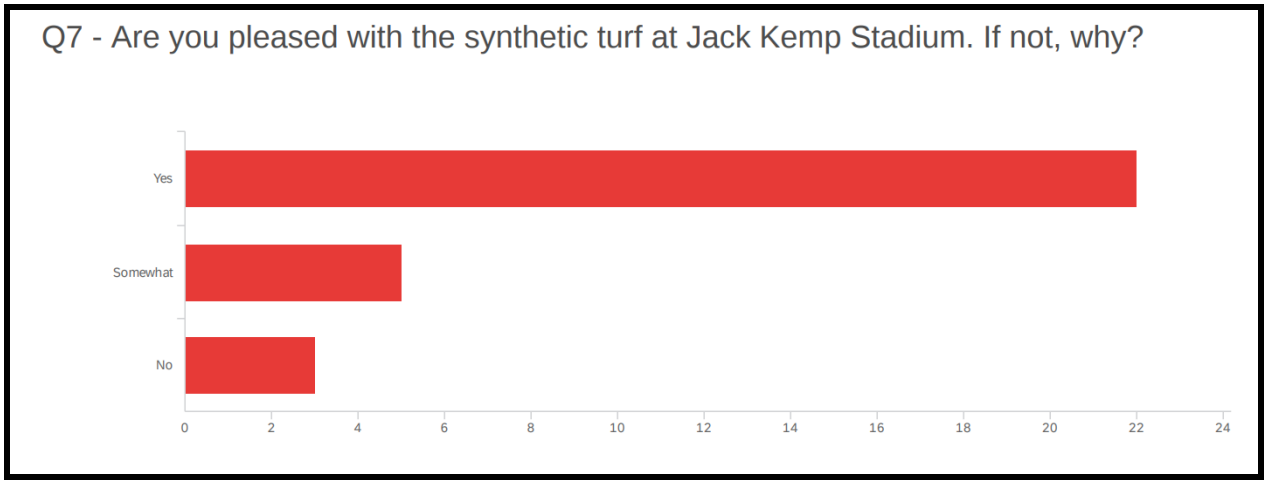


Figure 7: Approval rating of the new synthetic turf field at Jack Kemp Stadium from the survey.

There is a visible increase in the approval rating of the new synthetic turf, but it is important to acknowledge that people are still dissatisfied. After one soccer season with the new field, one athlete suffered a serious ACL injury which they believed the surface contributed to the severity of the injury.

Available Surface Types and Field Quality at Home

Both men's and women's soccer teams have a diverse group of players from all over the country and world. 13 different states from across the country are represented, on top of international players representing Bermuda, Guatemala, Japan, England, Amsterdam, and Poland. With this in mind, Figure 8 displays the types of soccer field surfaces that are available to players in their hometowns.

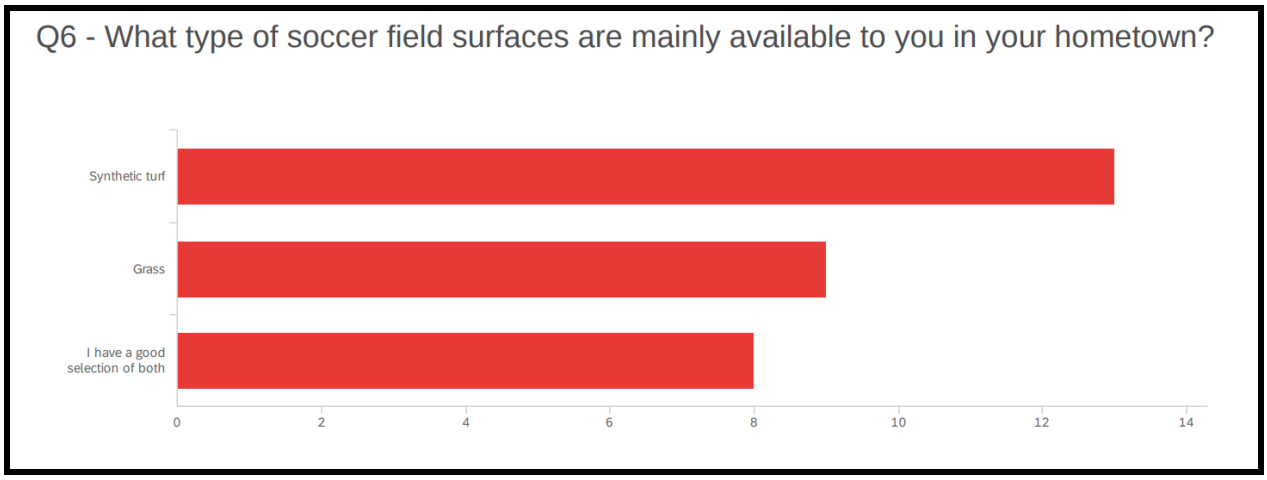


Figure 8: Available soccer fields in survey participants' hometowns by type.

While having soccer fields available is important, it is just as crucial to consider the quality of the field. Figure 9 represents the quality of fields available to the respondents in their hometowns. This is particularly important considering that all respondents play a form of pick-up/recreational soccer and 93.3% of respondents seek out public soccer fields to train in the off-season.

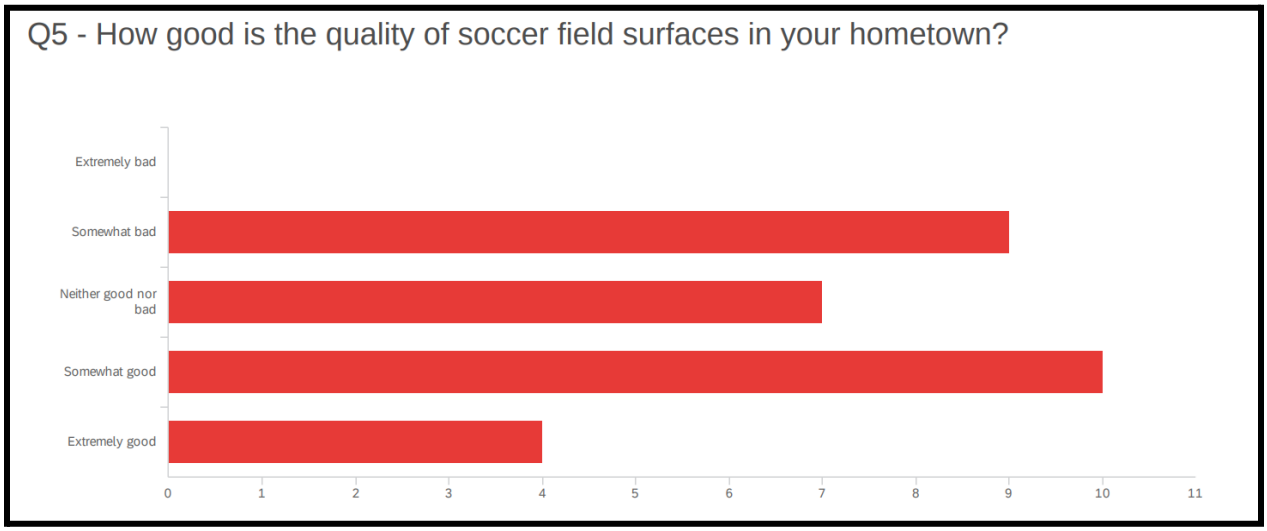


Figure 9: Quality of soccer fields in survey participants' hometowns.

Looking at the results, it is evident that there is a lot of variance in the dataset which makes it difficult to draw specific conclusions about the quality of synthetic turf and grass soccer

surfaces in the surveyed players' hometowns. Figure 10 represents the quality of the soccer field by surface type by combining the respondent data from Figure 8 and Figure 9.

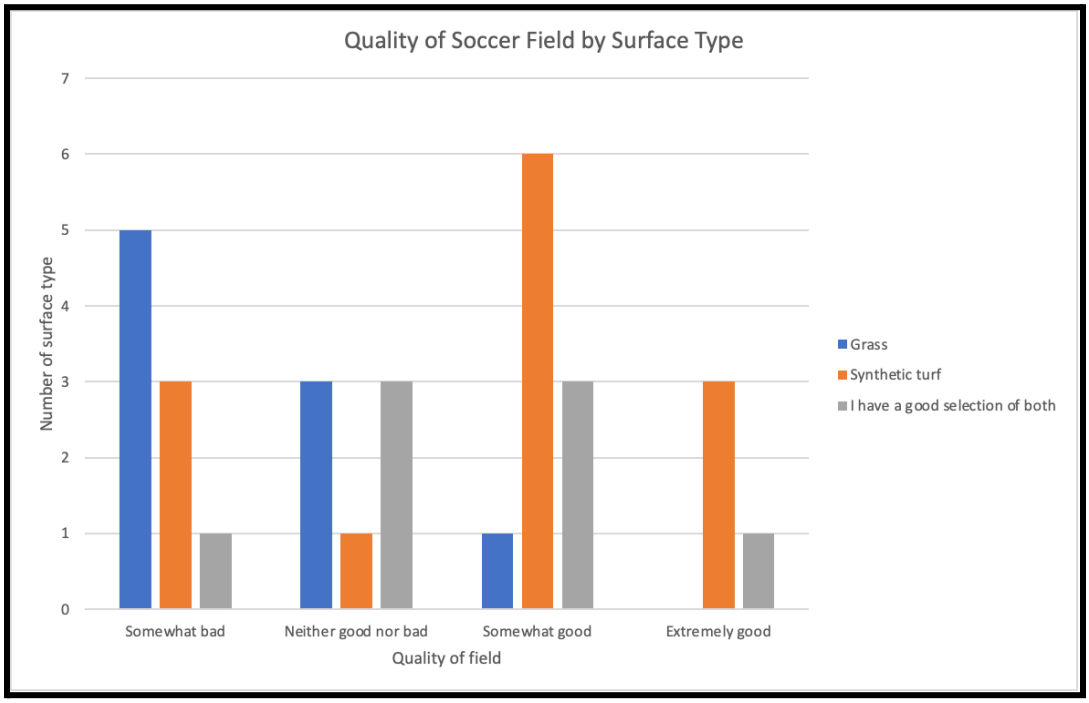


Figure 10: Quality of soccer field by surface type.

The graph displays that there is an association between access to good-quality soccer fields and synthetic turf surfaces. Furthermore, responses for bad quality grass soccer fields were the highest compared to any other group. The gray bar represents people who have a good selection of both grass and synthetic turf fields in their hometown. Seeing that their responses were the highest for having access to surfaces that were considered somewhat good or neither good nor bad, it was important to further understand this group's opinions on synthetic turf surfaces. After further examination, four of the respondents in the gray bar were indifferent about playing on synthetic turf, two did not enjoy it, and two enjoyed playing on the surface. Furthermore, six of the respondents from this group were pleased with the new synthetic turf field at their university, with one being somewhat pleased and one not being pleased. The respondent that was not pleased elaborated on this choice by stating, “although it is new, they

(Occidental College) re-used the same type of turf pellets (crumb rubber) as the old field, which are uncomfortable to play on and rub off on any surface touching it (shorts, socks, backpacks, skin).” With this understanding, it is important to consider what the surveyed players think of when reflecting on a “good quality” soccer field. Is it related to the surface? Or is there more to consider than that?

The “Good Qualities” of a Soccer Field

When asked about the qualities of a good soccer field, many players averted from speaking about the type of surface but instead spoke about other surface qualities, the playing experience, and other items that make up a soccer field. For instance, one respondent said “Well maintained, flat surface (not too bumpy or holey)” while others said, “Even, flat, decent (ball) bounce… soft surface, the ball moves well… No holes, well-painted lines, good nets, and goals.” When people referenced the surface type, it was overwhelmingly in favor of grass, but some did state synthetic turf. With this in mind, Figure 11 shows the opinions of participants when asked if they like playing on synthetic turf.

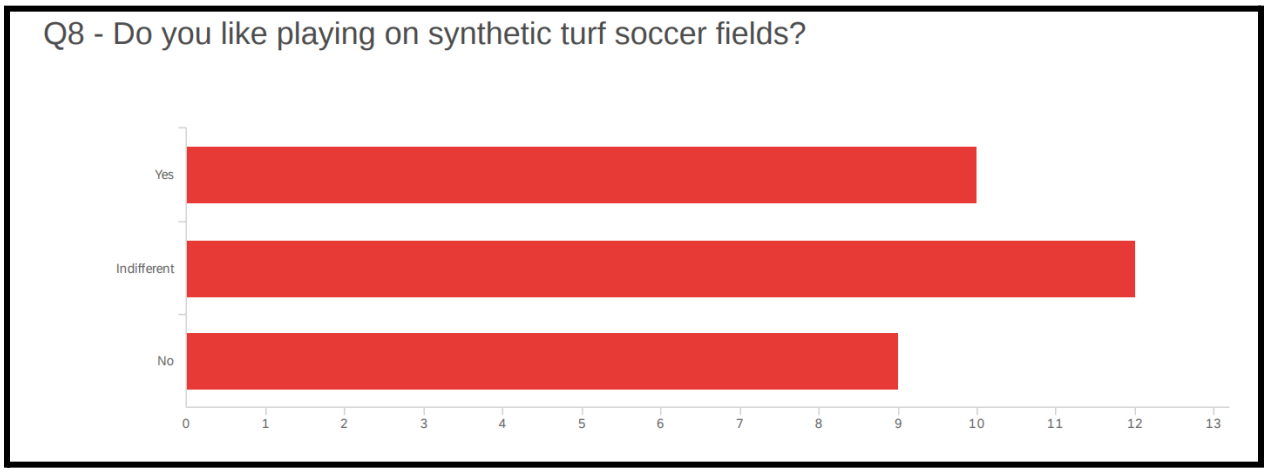


Figure 11: Opinions of survey participants on synthetic turf.

This paired with the previous responses displays that among these college soccer players, the playing surface is not as important as the ability to play on a well-maintained field.

Analysis

Considering the findings, synthetic turf is still a complicated debate. Opinions varied, and there were strong arguments on both sides. Therefore, it is crucial to frame this study as understanding the benefits and tradeoffs of synthetic turf soccer surfaces instead of picking one type over the other. It is clear that while synthetic turf has its benefits, like cost-effectiveness and durability, there are many concerns about injury rates, environmental hazards, and the industry's marketing of the product as low maintenance. It is important to note that synthetic turf is improving. Organic infill is being developed and companies like Urban Soccer Park provide sustainable models for small-sided soccer while moving away from crumb rubber by developing organic sand infill. Models like this seemingly reduce the perceived tradeoff behind synthetic turf, but at a notable price. While synthetic turf soccer field development is quoted on the higher end at $125,000, Urban Soccer Park cost $150,000, without considering any additional costs. However, would LA Parks and the city council value the benefit of these fields over the cost? Well, they should.

Low park staffing is a problem that is impacting LA Parks and the communities they serve. Essentially everyone interviewed and surveyed valued well-maintained grass soccer fields over any other surface, but also acknowledged how unrealistic it is for public parks to upkeep the surface. SHPF was the main advocate for grass fields, but the concept of accessible grass soccer fields for all, while ideal in theory, does not seem feasible for Los Angeles right now with limited park space and serious drought. Small-sided synthetic turf soccer fields solve these

problems. While consistent maintenance on these fields is crucial, the durability of synthetic turf heavily reduces the pressure of maintenance required by grass fields.

The biggest tradeoff with synthetic turfs seems to be injuries. While there is a risk associated with every sport, on any surface, the amount of concern around synthetic turf from those who experienced, treated, and studied injuries was significant. However, as synthetic turf makes strides toward an environmentally sustainable model, it is hopeful that future models can break the stigma around injuries by improving safety.

It cannot be stressed enough that organic sand is a major environmental improvement from crumb rubber for synthetic turf. In previous literature, it seemed like crumb rubber was the best option for synthetic turf, in terms of cost-effectiveness and maintaining player performance. However, organic sand is just as shock-resistant and permeable, does not trap heat, and is a clear step forward for the synthetic turf industry and the environment. As these infills are developed, it will be interesting to see their affordability as the data from this study and previous literature recognized cost as a barrier in more sustainable types of infill.

Policy Recommendation

These recommendations are informed by the data and literature review undertaken for this project. The goal of the recommendations is that Los Angeles solves maintenance issues in public parks by effectively analyzing the possibility of developing sustainable sports infrastructure through small-sided synthetic turf fields. To ensure environmental quality, these recommendations encourage passing legislation that encourages efficient environmental standards of those spaces. To achieve this, there are three aspects of the policy:

1. Develop regulations for synthetic turf around field maintenance and environmental hazards through a collaboration between the city's Energy and Environment, Planning and Land Use Management, and Public Safety Committees.
2. Reapply the 50 Parks model to Urban Soccer Park's small-sided synthetic turf infrastructure through a $3,750,000 investment in developing 25 small-sided soccer fields across the city.
3. Incorporate cooling methods to mitigate the effects of heat islands from synthetic turf. Specifically, examine the effectiveness of organic sand infill.

Establishing a Task Force within the City Council

An interdisciplinary task force is needed to address the concerns of synthetic turf and maintenance. This study considered previous research from a multitude of sources across many disciplines and presented data from a similar variety. A successful task force requires the eager collaboration of the Energy and Environment, Planning and Land Use Management, and Public Safety committees. While there may be gaps in knowledge, the data from this study provides a roadmap for future research and deliberations around developing the best synthetic turf models.

The demand for soccer spaces is only increasing and with the pressure of the upcoming 2026 World Cup and 2028 Summer Olympics coming to Los Angeles, the city will be looking for ways to encourage sports infrastructure in its communities. This sort of planning is a long-term investment in the city and the role of this task force would be to work with Los Angeles County's Environmental Review Committee and LA Parks to bring forward a sustainable small-sided synthetic turf model and ensure the consistent maintenance of these fields. With concerns around heat exposure and PFAS regulation, it is also important to observe

state actions around synthetic turf, like California SB 499, SB 414, and other bills mentioned in this study. To ensure the goals of this task force are in line with current rules and regulations around synthetic turf, the task force will also monitor current state bills to ensure that the new synthetic turf infrastructure is sustainable and in accordance with environmental ordinances.

Reapplying the 50 Parks Model

The 50 Parks model worked so well for Los Angeles because it presented economically conscious methods to develop public parks and playgrounds in park-poor areas of the city by incorporating community stakeholders, realistic budgets, and considering the limited space in the city. The developed parks were 5,000 to 20,000 square feet and cost between $250,000 to $700,000. The dimensions and cost of Urban Soccer Park's small-sided synthetic turf fields are both below these figures at around 4,500 square feet and cost roughly $150,000. This price includes the shipping, development, and amenities of the field like containment walls, organic infill, and sustainable containment netting (Urban Soccer Park, Accessed March 2023). While it is still expensive and the estimated $3,750,000 investment for the 25 fields does not include potential costs for field leveling, lights, etc., the benefits of these free-to-play fields for Los Angeles are invaluable. Numerous states and other cities in California are already investing in Urban Soccer Park as areas like Carson, San Francisco, Santa Barbara, and Marin are developing these spaces (Urban Soccer Park, Accessed March 2023). As mentioned the benefits of these spaces goes beyond the World Cup and Olympics and will truly revolutionize soccer access in communities.

Furthermore, Urban Soccer Park's model is moveable and if the fields, while highly unlikely, were to negatively impact the city and communities they serve, the process of removing them is easy.

The 50 Parks Model prioritized sustainable development to reduce the strain on maintenance. Many interviewers across all groups highlighted synthetic turf for its ability to be drought-resistant and withstand daily high-volume foot traffic. With the amount of foot traffic on a small-sided soccer field, it is unrealistic for the city to maintain a grass field. If the task force was to look at the small-sided field at Glassell Park, they would find a perfect example of a synthetic turf field that would be amplified in terms of durability, sustainability, and safety through the Urban Soccer Park model. By improving the maintenance of these fields, the spaces would have a massive impact on the city by increasing access to soccer fields for marginalized communities and establishing the sport as an integral part of the city.

Creative Solutions to Heat Islands

As the GIS data displays, synthetic turf fields place people at a higher risk of heat exposure than grass fields. This was also enforced in previous literature and across the board by all interviewed groups and survey participants. However, the lower heat anomalies at small-sided soccer fields in Los Angeles prove that certain models of synthetic turf fields can reduce heat exposure. While this is important, there is more that can be done. Through creative thinking, the task force can work with urban planners to research types of cooling systems or shade covering to reduce the effects of synthetic turf heat islands. In terms of a built-in cooling system, the cost is a consideration. The newly developed sand infill from Urban Soccer Park traps significantly less heat than crumb rubber and could be crucial for this heat consideration since the cost is already included in the field development (Urban Soccer Park, Accessed April 2023). Therefore, the first plan of action for the research team will be to analyze the effectiveness of organic sand infill. This can be done through research of the infill which will require direct collaboration with Urban Soccer Park and consulting with current owners of the field, whether private or public

sector, about the effectiveness of the infill. There are also many things to consider with a shaded canopy, like the height of the shade, how much shade is needed, and how the shade changes with the movement of the sun. To see if types of built-in cooling systems or canopy shade covering are effective, certain fields can incorporate this and monitor the success or failure of the initiative. However, research around organic sand infill should be the top priority. The importance of this proposed plan is that it aims to understand and address environmental concerns of synthetic turf, instead of further polarizing people around potential hazards.

Conclusion

There is a lot of uncertainty around synthetic turf soccer fields. Parents, coaches, players, organizations, and scholars are seemingly split between the benefits and tradeoffs of using the surface. However, it is undeniable that many regions are relying heavily on the product. Synthetic turf is valued for its cost-effectiveness, durability, and drought-resistant, but there are also environmental concerns around increased heat and toxin exposure. With many public parks experiencing serious staff turnover since the pandemic, the cost and labor of maintaining grass soccer fields in public parks are not feasible. Therefore, synthetic turf fields are a plausible option for developing and maintaining public soccer fields in Los Angeles.

Small-sided synthetic turf fields are a feasible way to reduce costs and maintenance concerns while also mitigating the environmental impacts of the surface. The smaller field size produces less heat on hot days, takes up less space, and provides the perfect environment for locals to play recreationally. With the demand for soccer spaces in the city increasing, small-sided soccer fields are a sustainable and efficient option for the city to develop its sports infrastructure and increase equity in access to soccer fields.

Los Angeles must evaluate the costs and benefits of investing in 25 Urban Soccer Park small-sided fields throughout the city. By creating a task force that analyzes public soccer fields in the city using the metrics in this paper, the city can decide the impacts of this proposed policy for all stakeholders. Through inspiration from the 50 Parks Program, Los Angeles can develop a roadmap to become the future hub for accessible public soccer.

Appendix

Appendix A:

Questions for park officials and public sector. (interview)

What thought process goes into developing public soccer spaces?

How long does it take to develop a synthetic turf soccer field?

How expensive is it to develop a synthetic turf soccer field?

Do synthetic turf soccer fields pose an environmental risk?

Do synthetic turf soccer fields pose an injury risk?

Are you pleased with the facilities at your local public park?

Is there a benefit to using synthetic turf?

Is synthetic turf easier to manage than grass at the local level?

Questions for community members and stakeholers. (interview)

How often do you or your child play soccer a week?

Do synthetic turf soccer fields pose an environmental risk?

Do synthetic turf soccer fields pose an injury risk?

Are you pleased with the facilities at your local public park?

Is there a benefit to using synthetic turf?

Questions for soccer coaches. (Interview)

Have you seen a significant increase in soccer popularity over the last decade?

Do you seek out public soccer facilities to train individually?

Do you seek out public soccer facilities to train and play with others?

Do you like playing on synthetic turf?

Have you ever been injured on a synthetic turf field?

If yes, do you think the turf field's conditions contributed to the severity of that injury?

Have you ever gotten a “turf burn?”

Do you avoid turf on extremely hot days? Do you think it should be?

Questions for environmental advocates and researchers who are knowledgeable in public spaces. (interview)

Are soccer fields effective for community development?

What role do these spaces play for local youth?

Does synthetic turf negatively impact the environment? If so, how?

Considering the debates around synthetic turf, do you think that there are other uses/better surfaces for public sport spaces?

Questions for Athletic Trainers. (Interview)

In terms of soccer, do you think turf puts athletes at a greater risk of injury than turf? If so what specific injuries?

How important is maintenance for playing surfaces?

Do poorly maintained grass surfaces put athletes at a risk of injury?

Have you dealt with injuries this year that you think were made worse by the synthetic turf surface?

Is there any surface specific training that you receive as an athletic trainer?

Are turf burns and grass burns the same injury in terms of treatment?

Appendix B:

Link to Survey

Survey Questions:

1. **Soccer has significantly increased in popularity over the last decade.**
2. **Are there public soccer fields in your hometown?**
3. **Do you play small-sided soccer/pickup soccer?**
4. **Do you seek out public soccer facilities to train individually/play with others?**
5. **How good is the quality of soccer field surfaces in your hometown?**
6. **What type of soccer field surfaces are mainly available to you in your hometown?**
7. **Are you pleased with the synthetic turf at Jack Kemp Stadium. If not, why?**
8. **Do you like playing on synthetic turf soccer fields?**
9. **Have you every gotten a turf burn? If yes, where on your body?**
10. **Have you ever been injured on a synthetic turf field, excluding turf burns? What was the injury and in what way did the turf conditions contribute to the injury, if at all?**

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