Go, Pack, Go!

Green Bay Packers' Titletown Development Sustainability Recommendations

Team

Wiles Kase | Robert Kraynak | Melissa Morton | Sean Pavlik | Kavya Vayyasi

Faculty Advisors

Professors Joe Arvai | Mark Lindquist

Master's Project for the University of Michigan
School of Natural Resources and Environment

April 18, 2017

Contents

1. Acknowledgements
2. Executive Summary
3. Introduction
    - Phase I
    - Phase II
4. Client Overview
    - Current Sustainability Initiatives
5. Peer Organization Efforts
    - The Green Sports Alliance
    - The National Football League
    - The Philadelphia Eagles
    - The Cleveland Browns
    - University of Michigan Athletic Department
    - Sustainability Consultant Lindsay Arell
6. About the Project
    - The Initial Project Scope
    - Scoping the Project - Titletown Sustainability Analysis
    - Scoping the Project - Packers Organizational Sustainability Strategy
7. Research Methods
    - Phase I
        i. Green Bay Packers
        ii. Titletown Development Stakeholder Interviews
        iii. Artificial Turf vs. Natural Grass Analysis
        iv. Energy-Efficient Lighting Design Data Collection
    - Phase II
        i. Parent & Peer Organizations
        ii. Local Stakeholder Interviews
8. Recommendations
    - Phase I
        i. Titletown: Artificial Turf Alternatives vs. Grass Field for Playfield
        ii. Titletown: Sustainable Options for Lighting
    - Phase II
        i. Green Bay Packers: Organizational Sustainability Strategy, Institutionalization of Sustainability Processes
9. Next Steps
10. Appendices

Acknowledgements

The authors would like to thank the many people who helped us carry out this rewarding consulting engagement. First and foremost, we thank the Green Bay Packers organization--specifically Aaron Popkey, Ed Policy, and Ted Eisenreich--for their time, attention, and direction throughout this project. We would like to thank the Murphy family for their hospitality, which made traveling to Green Bay feasible and delightful. For his incredible contributions to this project, we are sincerely grateful to Michael Cantor, whose kindness, patience, focus, and depth of knowledge fast-tracked our progress and made our team's efforts immeasurably more valuable. Thank you to our SNRE advisors, Joe Arvai and Mark Lindquist, whose timely insights redirected the project in vital, immensely positive ways. Thank you to the many stakeholders--principally among them Lindsay Arell, Bob White, and the Rossetti design staff--who shared their knowledge, perspective, and energy with our team. Finally, our heartfelt appreciation goes to our families for their support and love.

Executive Summary

Based out of Green Bay, Wisconsin, the **Green Bay Packers** are a leading professional football franchise within the National Football League (NFL). Our SNRE capstone master's project focused on developing sustainability-oriented recommendations for the Packers organization.

The Green Bay Packers, founded in 1919, are the NFL's only publicly-owned team - a rarity in today's professional sports landscape - and are located in the NFL's smallest city of its 32 teams.[1] This unique ownership and media market structure forces the Packers, out of economic necessity, to invest in the greater Green Bay area to ensure that it remains an economically viable market for a pro-sports franchise. Additionally, it heightens the importance of outreach to new Packers fans in different geographies as a means of new growth. The Packers are strongly committed to their community and large fan base, and are economically successful with over $408 million in revenue generation in 2015.[2]

The Packers have achieved great success on the field with 13 championships--the most in NFL history[3]. However, they are still in the early stages of successfully incorporating sustainability into the organization. The Packers' sustainability work is conducted through the Director of Public Affairs position in the front office as well as an internal "Green Team", the latter of which is currently inactive. Over the past several years, the Packers have developed several sustainability-oriented initiatives: a tree-planting "First Down for Trees" program, recycling studies with local university student initiatives, identification of efficiency improvement projects within their stadium, and waste reduction partnerships. These initiatives are independent and are not aligned with any overarching organizational sustainability goals or mission.

The **proposed objectives** of this SNRE master's project were split into two phases. Phase I, completed in Spring 2016, focused on developing recommendations to minimize the environmental impacts of the soon-to-be built Titletown Development business promenade outside Lambeau Field. Phase II centered around the creation of a set of organizational sustainability strategies involving process recommendations for future sustainability initiatives.

Our team utilized a mixed **research methods** approach as we embarked on our project work. This first involved internal stakeholder interviews and informational interviews with peer organizations. Second, our team surveyed current literature and research in the field of sports sustainability. Last, we examined local regulations and community needs in the greater Green Bay community. **Analytic methods** include Structured Decision Making, cost-benefit analysis, and other secondary sustainability research.

---

[1] CBS News. "The most committed fans in football." October 2, 2014. Accessed at http://www.cbsnews.com/news/green-bay-packers-smallest-market-in-nfl-but-most-loyal-fans/ on April 16, 2017
[2] Richard Ryman. USA Today Network-Wisconsin. "Packers' record revenue: $408.7 million." June 24, 2016. Accessed at http://www.packersnews.com/story/news/2016/06/24/packers-record-revenue-4087-million/86180816/ on April 16, 2017
[3] Packers.com Accessed at http://www.packers.com/history/super-bowls-and-championships.html on April 16, 2017

Phase I centered on the **Titletown Development**, a $130 million, 34-acre commercial center and public park that the Packers are developing next to Lambeau Field. The Titletown Development began with no goals for sustainability. Sustainability is important and relevant in the Titletown Development because of the large environmental footprint and community-centric vision of this commercial area. Working with numerous stakeholders involved in the Titletown Development design phase, our SNRE team identified two main areas where we could provide robust sustainability recommendations. First, our team performed an artificial turf versus natural grass sustainability analysis for a high-visibility, football-sized playfield within the ten-acre park. Second, we conducted an analysis of energy-efficient outdoor lighting for the Titletown Development site, evaluating the industry's best practices and innovative market offerings that would meet the aesthetic and regulatory needs for the Titletown district.

Phase II shifted our focus to providing the Packers with an organizational sustainability strategy. This strategy outlined frameworks to be used to institutionalize sustainability within the Packers' organizational culture in order to allow for the long-term success of sustainability initiatives. We spoke with peer organizations and industry experts to gain an in-depth understanding of best practices to inform our strategy recommendations. To ensure that the recommendations aligned closely with the Packers' organizational needs, both within the organization and within the local community, we engaged with numerous internal and external stakeholders. Our deliverables included the development of a sustainability goals "1-pager" to guide long-term goals and initiatives around four focus areas of importance to the Packers.

Our team's **deliverables and impact** included specific sustainability implementation recommendations for the Titletown development as well as a sustainability goals document aimed at catalyzing and deepening the Green Bay Packers' commitment to sustainable practices. Deliverables were presented to Packers leadership in Green Bay, Wisconsin, in April 2016 (Phase I) and December 2016 (Phase II).

Finally, as our SNRE team ends its formal engagement with Packers in April 2017, we sought to identify some concrete, actionable items for the Green Bay Packers to begin implementing sustainability into their organization based on our work. The Packers can benefit from pursuing these next steps to begin their journey of creating a culture of sustainability within the organization to follow the goals and initiatives included in our organizational sustainability goals document.

Introduction

While some league trendsetters have made strides in stadium sustainability, the National Football League (NFL) as a whole, and most teams individually, have not significantly addressed the issue.[4] While the NFL has engaged in some of its own sustainability initiatives, there is no league mandate to its member teams.[5] However, sports organizations are increasingly adopting sustainability strategies, and senior executives of sports leagues are acknowledging the potential strategic benefits of "greener" practices.[6]

The Green Bay Packers (or, the Packers) are in the early stages of addressing sustainability. The Titletown Development, a 34-acre commercial center that the Packers are developing next to Lambeau Field, began with no goals for sustainability. Sustainability is important and relevant in the Titletown Development because of both the large environmental footprint of this commercial area as well as the potential impacts on long-term economic development in the Green Bay community. Sustainability is also relevant in the operations of Lambeau Field, as stadiums and commercial centers consume large amounts of energy and fans create large quantities of waste during games and other events. Furthermore, the Packers organization needs effective strategies to communicate its current and future sustainability efforts to the public.

American football is the most watched sport in the United States,[7] providing ample opportunity for NFL teams to utilize the media coverage of the sport to convey the benefits of a sustainability strategy. As has been seen in the case of the Philadelphia Eagles' sustainability efforts, an organization which achieved their goal of sourcing 100% of their electricity consumption from solar and wind energy,[8] NFL teams can create considerable favorable attention for sustainability initiatives.[9] The Green Bay Packers' strong connection to both their fanbase and their local community positions them to benefit from not only the increased savings from more sustainable operations, but also the concomitant goodwill that these strategies would generate.[5] Babiak and Trendafilova note in "Corporate social responsibility in professional sport: motives to be 'Green,'" that sports organizations are increasingly adopting sustainability strategies, and that senior executives of sports leagues are acknowledging the potential strategic benefits of "greener" practices. Through addressing sustainability within their operations, sports organizations are "averting legal recourse, saving money, as well as building

---

[4] Dietl, Helmut, Egon Franck, and Julia Hillebrandt. "Corporate social responsibility in professional team sports: UEFA Champions League (UCL) versus National Football League (NFL)."
[5] Personal Communication with Jack Groh. National Football League. October 16, 2016.
[6] *Social Responsibility and Sustainability in Sports. Ediciones de la Universidad de Oviedo, Oviedo, Spain* (2009): 59-80.
[7] Babiak, Kathy, and Sylvia Trendafilova. "Corporate social responsibility in professional sport: motives to be 'Green'." *Social Responsibility and Sustainability in Sports. Ediciones de la Universidad de Oviedo, Oviedo, Spain* (2009): 31-58.
[8] Go Green. (2017). Philadelphia Eagles. Accessed at http://www.philadelphiaeagles.com/community/gogreen/renewable-energy.html on April 15, 2017
[9] Dietl, Helmut, Egon Franck, and Julia Hillebrandt.

stronger relationships with key stakeholders such as customers, fans, local communities in which they operate, local, state, and federal governments, and corporate partners."[2] As an influential organization in the Green Bay region, the Packers have the potential to set the precedence for other local public and private organizations to initiate sustainability efforts.

The objective of our engagement with the Green Bay Packers on sustainability initiatives was twofold: to provide the Packers with concrete sustainability recommendations to be implemented within the Titletown Development, and to provide the Packers with recommendations for a high-level sustainability strategy that will guide their future sustainability efforts.

Phase I

For the first phase of our project, we engaged with Sterling Project Development (SPD), the firm managing the Titletown Development. Through our work with SPD, we connected with both Rossetti, the architecture firm, and Biederman Redevelopment Ventures, the firm providing event programming and operations support for Titletown, in order to identify opportunities for sustainability initiatives within the development. Through these engagements, we scoped two main areas where we could provide robust sustainability recommendations. The first focus area was an artificial turf versus natural grass sustainability analysis for a football-sized playfield within the ten-acre park. Through our study, we examined a range of artificial turf and natural grass options to determine the lifecycle impacts, the potential health risks and benefits, and the ecosystem impacts. We additionally provided a cost-benefit analysis of the various options. We presented the results to the Green Bay Packers' leadership team in April 2016, using a decision-making framework to inform and influence the Packers to choose the most sustainable option that served the needs of their overall business strategy.

The second area that we focused on was an analysis of energy-efficient outdoor lighting. We worked in collaboration with the Titletown lighting designer, Bob White, from Illuminart in Ypsilanti, Michigan, to understand the industry's best practices for energy-efficient outdoor lighting that would meet the aesthetic and regulatory needs for the Titletown district.

Phase II

As we worked with the Green Bay Packers during the first phase, it became clear to us that while the Packers were excited to begin undertaking the types of sustainability initiatives for which we provided guidance and recommendations within the first phase, they did not have a clear organizational strategy to guide their sustainability efforts both within the Titletown Development and overall operations. Therefore, for the second phase of our project, we shifted to providing the Packers with an organizational sustainability strategy. This strategy outlined frameworks to be used to institutionalize sustainability within the Packers' organizational culture in order to allow for the long-term success of sustainability initiatives. We spoke with peer organizations and industry experts to gain an in-depth understanding of best practices to inform our strategy recommendations. To ensure that the recommendations aligned closely with the Packers' organizational needs, both within the organization and within the local community, we

engaged with numerous internal and external stakeholders.

Client Overview

The Green Bay Packers, founded in 1919, are one of the National Football League's oldest and most successful franchises. The Green Bay Packers' success has manifest in the form of 13 national football championships and large annual team revenues--$408 million in 2015.[10] They are the National Football League's only publicly-owned team, a rarity in today's professional sports landscape. Instead of the traditional ownership model, in which one wealthy businessperson, scion, or corporation owns and directs the decisions of the franchise, the Packers are owned by shareholders, who elect a board of directors that runs the corporation by proxy by selecting a seven-person executive committee. This ownership structure exists to ensure that no shareholder benefits financially from the Packers business operations, and, indeed, until 1997, in the event the Green Bay Packers were to be sold, the proceeds would have gone to the Sullivan-Wallen Post of the American Legion to build "a proper soldier's memorial."[11] Currently, a sale of the Packers would return post-expense monies to the Green Bay Packers Foundation.[12]

The direct result of this ownership structure on Packers business operations is manifested in two growth imperatives: first, it forces the Packers, out of economic necessity, to invest in the greater Green Bay area to ensure that it remains an economically viable market for a pro-sports franchise; second, it heightens the importance of outreach to new Packers fans in different geographies as a means of new growth.

Although the Packers act as a cultural icon for the entire state of Wisconsin, the local area governments of Brown County, the Village of Ashwaubenon, and the City of Green Bay are most directly impacted by Packers initiatives, due to geographic proximity and that the Titletown Development site spans both jurisdictions. For this reason, we focused our government stakeholder research on these three entities. **Exhibit 1** provides an overview of these geographic entities.

[10] Milwaukee Wisconsin Journal Sentinel. "Packers report record $408.7 million in revenue" June 24, 2016. Accessed on April 16, 2017 at http://archive.jsonline.com/sports/packers/packers-report-record-4087-million-in-revenue-b99750517z1-384322901.html.

[11] Packers.com. "Shareholder History & Financial History" 2014. Accessed on March 1, 2016 at http://prod.static.packers.clubs.nfl.com/assets/docs/shareholder-history-2014.pdf.

[12] Zirin, Dave. "Those Non-Profit Packers" January 25, 2011 in The New Yorker Online. Accessed on March 1, 2017 at http://www.newyorker.com/news/sporting-scene/those-non-profit-packers.

Exhibit 1: Green Bay Geographic Entities[13]

Current Sustainability Initiatives

Internally, the Packers sustainability initiatives have historically revolved around the First Down for Trees program, identification of land-use initiatives in collaboration with the outfitter company Cabela's, University of Wisconsin-Green Bay (UWGB) student initiatives similar to our own, energy auditing with a group called Focus on Energy, and the now-defunct Packers Green Team.

The most visible Packers sustainability program is **First Downs for Trees**[14], a program in partnership with the US Forestry Service and the Wisconsin Department of Natural Resources, in which the Packers plant one tree in a local community for every first down made during the football season. This program was conceived to offset the Packers own estimation of yearly carbon emissions for traveling to games[15] and has resulted in over 2,000 new trees planted in local communities. The communication and education element of this program has been the Packers' most significant sustainability outreach to date as well. Communication efforts have included multiple press releases as well as in-game messaging to approximately 80,000 attendees at Lambeau Field through the display of First Down for Trees' most recent activity on the scoreboard during home games.[16]

The Packers have attempted to balance the relationship between business and environmental preservation. To preserve other local areas within the organization's own land-holding, notably the wetlands around the popular Cabela's sporting goods store located at the western end of

[13] Rossetti Architecture. "Titletown PUD Submission." Published February 16, 2016. Accessed at http://www.ashwaubenon.com/Portals/Ashwaubenon/Departments/Administration/Titletown/2016_0219%20Titletown%20PUD%20PH1.pdf on March 17, 2017

[14] Packers.com. "Packers 'First Down for Trees" Program enters fourth season." September 13, 2013. Accessed at http://www.packers.com/news-and-events/article-1/Packers-First-Down-for-Trees-Program-enters-fourth-season/8b05b1cc-f08e-43b0-847d-2af650634844 on April 15, 2017

[15] Estimated to be 450 tons/ year: Packers.com. "Packers 'First Downs for Trees' plants 749 trees in local communities." May 30, 2013. Accessed at http://www.packers.com/news-and-events/article-1/Packers-First-Downs-For-Trees-plants-749-trees-in-local-communities/abd27c44-5f93-4a79-9e9b-d60c3ef1cc9a on April 15, 2017

[16] Personal communication with Aaron Popkey. Green Bay Packers. March 1, 2016.

the Titletown district, the organization has sought out external partnerships to mitigate habitat loss.[17] The **Cabela's** 21-acre development, begun in 2012, sits on top of 12 acres of designated wetlands and resulted in the destruction of 1.65 acres of wetland. To offset this loss, the Packers formed a partnership with the wildlife conservation non-profit Ducks Unlimited to create four acres of wetlands in the Fox River watershed in northeastern Wisconsin.[18]

While there is no overarching organizational sustainability strategy, the Packers have completed some one-off environmental sustainability projects. To counter municipal solid waste, the organization has launched short-term internal initiatives, such as a campaign in which employees were given multi-use coffee cups to reduce disposable cups in the workplace and a project examining the recycling behavior of fans within Lambeau Field conducted by **University of Wisconsin-Green Bay** (UWGB) students.[19] Waste is currently handled by **Waste Management** (WM) as a single disposal stream which is sorted by WM offsite for recycling or landfill.

To reduce energy consumption, the Packers have worked with **Focus on Energy**, a Wisconsin state government initiative to reward energy efficiency projects. Identification of these projects typically occurs on an annual to bi-annual basis and involves incremental shifts in technology to reduce the overall energy consumption footprint of Lambeau Field and the Hutson Practice Center. Recent projects have included replacement of older, less-efficient boilers with newer, more efficient models and the installation of motion detection systems on back-office rooms.[20]

Externally, the **Packers' Green Team**--established in 2008, though now inactive[21]--held meetings with sustainability groups from other NFL teams to share best practices and submitted proposals to a now-defunct NFL-managed sustainability newsletter to all teams.

[17] Lee Bergquist, Milwaukee-Sentinel Journal. "Cabela's to build store near Lambeau on site with wetlands." May 4, 2012. Accessed at http://archive.jsonline.com/news/wisconsin/cabelas-to-build-store-near-lambeau-on-site-with-wetlands-2h59hum-150180945.html on April 15, 2017

[18] Ibid.

[19] Personal communication with Aaron Popkey. Green Bay Packers. February 12, 2016.

[20] Personal communication with Focus on Energy representatives and Scott L. Hanson, Wisconsin Public Service Corporation. October 14, 2016.

[21] Personal communication with Aaron Popkey. Green Bay Packers. March 1, 2016.

Peer Organization Efforts

As part of our research efforts to inform our two project phases, we examined a variety of peer organizations and influencers who have made strides in the field of sports sustainability. This included national organizations (The Green Sports Alliance), leagues and teams (the NFL, Philadelphia Eagles, Cleveland Browns), academic institutions (the University of Michigan Athletic Department) as well as independent sustainability consultants (Lindsay Arell).

The Green Sports Alliance

Founded in 2010, the Green Sports Alliance (GSA) is a non-profit membership group focused on leveraging the cultural and market influence of sports, both at the professional and collegiate level, to support the development of healthy, sustainable communities.[22] To support this mission, the GSA hosts annual summits that connect leaders in this space, produces case studies that exemplify best practices, and shares resources and contacts with its members to support their individual sustainability needs.

As of March 2017, the GSA featured 379 members from 15 sports leagues.[23] This includes 19 of the 32 overall teams from the National Football League--the Green Bay Packers are not a member of the GSA as of April 2017. Additionally, leagues themselves can have a membership or partnership status with the GSA; three of the four major North American professional sports leagues are members: Major League Baseball (MLB), the National Basketball Association (NBA), and the National Hockey League (NHL). However, the National Football League (NFL) is notably absent from the list.

SNRE project members attended the June 2016 Green Sports Alliance Summit in Houston, Texas, to connect with sports sustainability leaders and learn of emerging trends and best practices. The 2016 Summit focused on “The Power of Partnerships” and featured two days of panel discussions, workshops and networking among sports stakeholders and interested parties. By attending the Summit, our team learned that professional sports teams, universities, and leagues are increasingly pursuing corporate sustainability sponsorships to fund projects as well as community engagement efforts related to sustainability. Additionally, several professional sports teams are involving their players in sustainability efforts where possible, such as in-person advocacy efforts with team fans and filming of public service announcements.

While there was a significant presence of MLB, NBA, and NHL leaders in attendance at the 2016 Summit, the NFL and its teams did not have any notable representation. The President of the GSA, Allen Hershkowitz, shared his wish during his keynote at the 2016 Summit that the NFL would follow the three other major North American sports leagues by developing “measurement programs for energy, waste, and water.” Following the Summit, our team connected with GSA Program Manager Dania Gutierrez, an SNRE alumna, and GSA executive

[22] The Green Sports Alliance. Accessed at http://greensportsalliance.org/about/ on March 11, 2017
[23] Ibid.

director Justin Zeulner for a discussion regarding the organization's mission and the benefits it provides to professional leagues and teams.

The National Football League

The NFL is comprised of 32 professional football teams in the United States, one of which is the Green Bay Packers. Sustainability is positioned at the NFL's corporate level under the domain of Anna Isaacson, VP of Social Responsibility, and her colleagues. The NFL directly coordinates sustainability efforts for the events under its specific control, including the Super Bowl and Pro Bowl.

From the league office, interactions with teams related to sustainability is minimal. Previously, the league office assisted in the coordination of regular sustainability-focused calls among team operations heads and public affairs directors. These calls were organized so that teams could share out best practices, and were deemed helpful by Green Bay Packers leadership.[24] However, the NFL ceased to organize such calls as of 2016.[25]

The Philadelphia Eagles

One of the most progressive North American sports franchises with regards to its sustainability efforts is the NFL's Philadelphia Eagles. In our initial interactions with Packers management, the Eagles organization was identified as an exemplar of sustainable operations and goal setting. This was also demonstrated through independent research as well as conversations with individuals associated with the Green Sports Alliance.

Our team conducted informational interviews with the Eagles' Director of Facilities, Director of Fan Experience, and Media Relations Coordinator to understand how they have developed a culture of sustainability within their organization. Eagles executives, particularly co-owner Christina Weiss Lurie, have played a key role in making sustainability efforts a priority for the organization and management. This leadership from the top of the organization was highlighted as crucial in all of our conversations with Eagles management, who shared that they view sustainability efforts as "the right thing to do."[26] Return on investment considerations are important to the Eagles but are not the only consideration when sustainability-related decisions are made.

The Eagles' sustainability efforts began in earnest in 2003 with the opening of their new football stadium. That year, the operations team received a monthly power bill that was exorbitantly high both in terms of cost and overall energy usage. This prompted leadership to assess opportunities for goal setting, partnerships, and investments that would make team operations more sustainable and cost competitive--both in terms of energy usage and other areas within sustainability.

[24] Personal communication with Aaron Popkey. Green Bay Packers. March 1, 2016.
[25] Ibid.
[26] Personal communication with Ryan Hummel. Philadelphia Eagles. October 20, 2016.

The Eagles have established a production partnership with NRG Energy in an effort to offset their full energy load through either onsite renewable energy or the purchase of renewable energy credits (RECs). Through this partnership, a combination of solar and wind generation accounts for 40 percent of their energy consumption for the whole year, while the remainder is offset with REC purchases.

Waste and recycling are other notable focus areas for the Eagles. What started as a simple recycling program with a blue recycling bin under each employee's desk has blossomed into a full-fledged waste management program where over 99 percent of waste is diverted from landfill.[27] Partnerships have been critical to the team's success in this area, with extensive work with the team's food and beverage vendor Aramark to ensure all food containers within their stadium are compostable. The team conducted studies and discovered that placing recycling bins within 30 feet of any point in the pavilion would be the most effective operational plan. On game days, sorting is done during the game within the stadium to ensure compost and recycling streams are separate. Compost is sent to local facilities in the Philadelphia region. The team has also achieved economic benefits from these operational decisions; the team is saving $500,000 annually due to increased recycled material sales process rather than those materials going to landfill.

Last, the Eagles have created an internal culture where sustainability is respected and considered in daily operations throughout the organization. The team started in a simple manner, with implementations such as having a blue blue bin under each desk to get buy-in from a majority of employees. Sustainability training sessions for new and existing employees were instituted alongside norms where a sustainability fact was presented during large assemblies of employees. The team has green committees who focus on strategic planning and tracking of programs through metrics.[28] Although the team does not actively seeking out public relations opportunities about its sustainability programs in general, they noted they are happy to speak to these issues with anyone when asked, as our team discovered.

The Cleveland Browns

The Cleveland Browns are another prominent example of a NFL team achieving progress with sustainability goals, with a particular focus on waste management. The team launched a food waste program in 2013, with the goal of diverting its food waste generated during games from landfills to anaerobic digesters.[29] The team was already sending approximately 10,000 pounds of unsold and untouched food annually to local food banks; however, the remainder was being sent to landfill.[30] The Browns worked with Quasar Energy Group to send organic waste to one of

[27] Personal communication with Brett Strohsacker. Philadelphia Eagles. October 6, 2016.
[28] Ibid.
[29] Jeff Bell. Columbus Business First. "Cleveland Browns team up with Quasar Energy to turn stadium food waste into energy." November 25, 2013. Accessed at http://www.bizjournals.com/columbus/news/2013/11/25/cleveland-browns-team-up-with-quasar.html on August 20, 2016.
[30] Rahel Gebreyes. The Huffington Post. "How The Cleveland Browns Are Helping To Turn Food Waste Into Renewable Energy." July 22, 2016. Accessed at

Quasar's anaerobic digesters. The project is expected to divert 35 tons of food waste from landfills each season and reduce associated CO_2 emissions by 28,000 pounds each year.[31]

University of Michigan Athletic Department

In 2013, the University of Michigan Athletic Department (UMAD) developed a "Sustainability Game Plan" 1-pager to create both long-term sustainability goals and more immediate initiatives. The Game Plan is centered around four main sustainability tenets that have been identified as priority areas: 1) Waste Reduction and Recycling, 2) Energy Efficiency/Built Environment, 3) Water and Chemicals, and 4) Education and Awareness. Our team utilized the Game Plan as a template for utilization for the Packers and their unique sustainability needs.

As part of the University of Michigan, the UMAD works closely with the campus-wide Office of Sustainability to share best practices and align goals and programs. For example, there have been recent efforts across campus to increase composting. Although previously hesitant to pursue such efforts, UMAD launched compostable materials for the 2016 football season in the Big House, working with local vendor We Care Organics.[32]

Sustainability Consultant Lindsay Arell

The Philadelphia Eagles referred us to their sustainability consultant Lindsay Arell, of Honeycombs Strategies. Ms. Arell is a sustainable operations consultant for venues and businesses. In addition to informing us about the initiatives undertaken by the Eagles, she provided us with a survey of current industry practices. One of these tools is the ISO 20121, an international standard for event sustainability management systems. This standard provides a framework for organizations to create management systems that allow for event sustainability to be successfully planned, implemented, refined, and improved.[33]

http://www.huffingtonpost.com/entry/cleveland-browns-renewable-energy-food-waste_us_578ebd20e4b0f180da638af on August 20, 2016.

[31] Ibid.

[32] Personal communication with Robert Rademacher. University of Michigan Athletic Department. August 3, 2016.

[33] ISO 20121. Accessed at http://www.iso20121.org/ on April 17, 2017.

About the Project

The Initial Project Scope

This section describes the client deliverables and methodology, as well as the process of scoping the project. The project included two primary areas of analysis and implementation: 1) focused analysis and sustainability strategies for the Titletown Development; and 2) development of long-term, organization-level sustainable processes for the Green Bay Packers. The deliverables submitted and research methods used tracked closely to those outlined in the initial project proposal, even after considerable changes in project scope. The following paragraphs describe the original proposal and the process of scoping the project.

The **proposed objectives** of this project originally included 1) developing recommendations to minimize the environmental impacts of the soon-to-be built Titletown business promenade, 2) creating an organizational sustainability strategy replete with feasible sustainability measures, and 3) advising on or developing outbound communications regarding sustainability efforts. Because the Green Bay Packers organization could not implement sustainability measures in the short-term and was hesitant about promoting its sustainability initiatives, we scoped out the third objective related to outbound communication.

Our team anticipated using a mixed research approach. Throughout the project, we employed all of the **anticipated data collection methods.** These included:

- stakeholder interviews and informational interviews;
- a survey of current literature on related products, relevant technologies (such as energy-efficient lighting and vehicles, water-saving products, irrigation), and local ecosystems;
- research on best practices for green buildings, public green spaces, and the built environment;
- a review of local regulations, such as parking and lighting requirements;
- a review and analysis of comparable sustainability plans for sports organizations; and
- primary data collection on ambient light levels in the commercial development area.

Anticipated analytic methods we expected to employ included Structured Decision Making, Life Cycle Analysis (LCA), and other secondary sustainability research. While carrying out the project, we relied on all three analytic methods, although we only referenced prior LCAs and did not perform one in depth ourselves.

Our **evaluation framework** originally intended to incorporate sustainability reporting metrics and indices, emphasizing open-source systems that could be tailored to the Packers organization and surrounding municipalities and scaled across NFL teams. For various reasons, this did not materialize--primarily because the organization was not prepared to make

organization-wide decisions about sustainability. In the end, we incorporated process management tools, instead, which will allow the organization to incorporate sustainability metrics in the future.

Finally, the original project **deliverables and impact** included a consolidated consulting portfolio (or "sustainability playbook") and sustainability plan, both aimed at catalyzing and deepening the Green Bay Packers' commitment to sustainable practices. The opportunities we saw for sustainability for the Green Bay Packers were diverse, and ranged from resource use to community resilience. A list of initial focus areas for the Titletown Development is below:

- Artificial turf versus natural grass field analysis for the "Playfield"
- Energy modeling for the Titletown sledding hill building
- Green roofs on the sledding hill and service building
- Green spaces
- Lighting
- Operations and waste management
- Parking lot space and other impermeable surfaces
- Stormwater and wastewater management
- Water efficiency in public bathrooms

Scoping the Project - Titletown

We began our work with the Packers by focusing on the Titletown Development for two reasons. First, the challenge facing the Titletown Development was more clearly defined than the task of creating an organizational sustainability strategy. Second, construction activities in the Titletown Development were underway, requiring us to make recommendations within 90 days of starting the project in February 2016.

The Packers referred our team to Michael Cantor, a Senior Project Advisor for Sterling Project Development (SPD), the real estate development firm leading the Titletown Development. Mr. Cantor's committed stance on various sustainability issues, combined with his knowledge of the Titletown Development, greatly accelerated the process of scoping the Titletown portion of our project. Through Mr. Cantor, we were introduced to the Detroit-based architect firm designing the development, Rossetti. Rossetti in turn provided documentation, design expertise, and a committal point of view about what elements of the development would most benefit from our analysis.

Based on conversations with Mr. Cantor and Rossetti, our team decided to focus our analysis on the sustainability of the construction of a playfield in the Titletown Development. As such we joined "design calls" with stakeholders including Rossetti (architects), SPD (real estate developers), Design Workshop (a landscape architecture firm), R.A. Smith National (civil engineers), and Biederman Redevelopment Ventures (BRV, a land-use firm dedicated to programming public spaces within the Titletown Development). These design calls provided

information on the intended uses of the space, construction scheduling constraints, and engineering requirements. During design calls, lighting in outdoor spaces emerged as an additional area of focus, where our sustainability analysis could add valuable information to the current design conversations. In the end, our team focused our sustainability analyses on these two Titletown issues: the construction of the playfield and the outdoor lighting.

Spring 2016 design mockup of the Titletown Development park and playfield (in pink)[34]

A number of compelling topics were scoped *out* of the project during the period of time when we were participating in Titletown Development design calls. **Water management** was a potentially impactful issue, with compelling adaptation measures available, such as bioswales and rain gardens; however, we were forced to avoid water issues because it depended on engineering analysis that had already been completed. The use and design of **green space** was also relevant to our analysis; however the architects at Rossetti, Design Workshop, and BRV principally drove that workstream because it so directly affected critical visual design outcomes. **Parking lots** and impermeable surfaces were dictated by local parking regulations, so recommendations from stormwater analysis we could have performed would have been negated by such regulations. Finally, **energy modeling and green roofs**, particularly on the sledding hill, were less important to the client; furthermore, the design decisions that would have affected our analysis were in a state of flux inherent to the design phase of any large project. Thus, we were forced to forgo this portion of our analysis.

During the summer of 2016, the next stage of the Titletown Development construction planning and design began, and the client asked us to develop recommendations for this subsequent construction activity. To best serve the needs of the client (i.e. to target our sustainability analyses), we engaged in a conversation about what motivations the organization had for pursuing sustainability. In the course of engaging with the Packers, we learned that the organization had few internal policies, goals, or underlying motivations to help focus our efforts during Phase II. Instead of pursuing many options without clear direction from the client, our

[34] Courtesy: Rossetti Architects

team shifted focus to the second portion of our project scope: developing an organization-wide sustainability strategy.

Scoping the Project - Organizational Sustainability Strategy

Our team's research quickly pivoted to engaging the Packers in discussions about the organization's inner motivations. We attempted to employ a granular, quantitative structured decisionmaking framework or tool, which stalled because we quickly realized no one within the organization had spent time forming a vision of or even opinions on the importance of sustainability within the organization. That is, no one at the Packers had thought about how sustainability might benefit the organization, and therefore no one at the Packers knew why or what they wanted from a sustainability strategy.

A meeting with our SNRE advisor, Professor Joe Arvai, helped us realize that a process needed to be in place within the organization for developing this vision. Professor Arvai proposed the notion that merely recommending such a process could be a valuable contribution and a deliverable of significance.

We began to concentrate our research on the Packers' peer organizations that had implemented such processes and developed visions for sustainability. This focus led us to speak with the representatives of the Philadelphia Eagles about that organization's experience and also spoke to Lindsay Arrell, a sports and large-event sustainability consultant working for the Eagles. Ms. Arrell spoke to us about how she involved the Eagles in conversations about sustainability, since her experience with the Eagles as a consultant was analogous to our relationship with the Packers.

Ms. Arrell introduced the idea of a process management system as a means of institutionalizing sustainability at the Green Bay Packers. Process management systems allow organizations to monitor and manage the effective creation of and adherence to *processes* instead of measuring and managing for *outcomes*.

When our team suggested that process to the Packers during a December 2016 meeting, we were met with a non-committal response. This response pushed us to generate more prescriptive recommendations for process management because the Packers had difficulty generating and executing on decisionmaking criteria. The recommendations we provided are discussed in the "Summary of Findings" section of this report.

Research Methods

The following section addresses our stakeholder engagement and data collection process in the creation of our deliverables for our two project phases.

Phase I

As our team embarked on Phase I of our project in February 2016, we sought out two key stakeholder groups to inform our research and project scoping: 1) Green Bay Packers front office leadership and 2) Titletown Development stakeholders. This led to the development of data collection process for our two main undertakings for Phase I of the project: 1) artificial turf versus natural grass analysis for the Titletown playfield and 2) energy-efficient lighting design.

The Green Bay Packers

Our team interacted with several key members of the Packers organization who are involved with sustainability planning and goal setting. Our primary contact was **Aaron Popkey**, Director of Public Affairs, whose responsibilities include managing sustainability programs and the now-defunct Packers Green Team. Mr. Popkey was the subject of several structured and unstructured interviews over the course of our project. He connected us with several individuals both within the Packers organization as well as peer and affiliated organizations such as the Philadelphia Eagles and the National Football League.

Within the Packers front office, Mr. Popkey introduced our team to **Ted Eisenreich**, Green Bay Packers Director of Facility Operations, who was helped us understand the operational status and priorities for both Lambeau Field and the organization as a whole. For our team's specific work related to the Titletown playfield, Mr. Eisenreich put us in touch with **Allen Johnson**, Green Bay Packers Fields Manager. Mr. Johnson provided significant expertise related to field management techniques, cost estimates, and turf varieties.

Our team also interacted with **Ed Policy**, Green Bay Packers Vice President and General Counsel. Mr. Policy is the Packers' internal leader handling the vision and implementation of the Titletown project. He observed both our initial April 2016 Titletown recommendations presentation as well as our final December 2016 sustainability plans presentation. Mr. Policy provided feedback and insights into organizational strategy needs and how the Packers could best implement sustainability into their organizational ethos.

In addition, to gain a better understanding of the existing facilities - Lambeau Field and the Hutson Training center - we engaged the Packers Operations team during an energy audit conducted by **Focus on Energy (FoE)**. Focus on Energy is "Wisconsin utilities' statewide energy efficiency and renewable resource program. Since 2001, the program has worked with eligible Wisconsin residents and businesses to install cost-effective energy efficiency and renewable energy projects."[35]

[35] Focus on Energy. Accessed at https://focusonenergy.com/about on April 15, 2017.

Through our interactions with these members of the Green Bay Packers' organization, we were able to understand stakeholder perspectives, as well as collect data pertinent to the operations of Lambeau Field and the Titletown Development.

Titletown Development Stakeholder Interviews

In order to identify specific focus areas for our Titletown Development Sustainability Recommendations, we interviewed stakeholders involved in designing and implementing the Titletown Development plans. Our main point of contact was **Michael Cantor**, Senior Project Advisor for Sterling Project Development. During Phase I, we spoke weekly with Mr. Cantor to receive updates on the Titletown Development's progress in order to better identify and focus our recommendations based on the needs and status of the development.

We interviewed **Jon Disbrow**, Architectural Lead at Rosetti, the firm handling Titletown Development design, to gain insights into the site plans and where there was room for improvements in sustainability efforts. Through our interview we were additionally able to procure blueprints, schematics, and renderings to aid our work. Additionally, we interviewed **George Roberts**, Project Manager, and **Brett Miriam**, Project Analyst, of Biederman Redevelopment Ventures (BRV), to gain insights into the potential uses for the playfield that were used to inform our artificial turf versus grass analysis and recommendations. We interviewed **Tom Reidy** of BRV, who manages the lawn care for Bryant Park in New York City, in order to gain insights into the required maintenance and associated costs of managing a natural grass field in a public space. In order to provide more specific sustainability recommendations regarding the water use of artificial turf and natural grass fields we spoke with **Ryan Lancour**, the Project Manager at R.A. Smith National, Inc., who managed all of the work related to the stormwater systems in the Titletown Development. Mr. Lancour provided us with both Titletown-specific insights as well as site schematics.

In addition to individual interviews described above, our team participated in **Titletown Development design conference calls** with the above individuals and groups throughout Spring 2016 to stay informed on changes to the site design as well as share out our findings related to the Titletown playfield.

Artificial Turf vs. Natural Grass Analysis

In order to provide an analysis on the most sustainable surface for the football-sized playfield in the Titletown Development park, we employed a methodology that included stakeholder engagement, data collection, cost-benefit analysis, and the employment of decisionmaking frameworks. To guide our data collection and analysis, we first engaged with both the Green Bay Packers and Biederman Redevelopment Ventures, the firm scheduling all event programming in the space, in order to best understand how the space would be used. Through conversations with multiple artificial turf companies including **SporTurf, AstroTurf, and FieldTurf**, we collected cost and maintenance data on artificial turf fields as well as specific data on multiple types of artificial turf infill including rubber crumb, sand (silica), thermoplastic elastomer (TPE), cork, and NikeGrind/EcoGrind. We visited a NikeGrind field at Appleton North

High School in Appleton, Wisconsin, and spoke to the school field manager to understand the maintenance needs of both the school's NikeGrind football field and natural grass soccer and baseball fields. We also spoke with the Green Bay Packers' Field Manager, Allen Johnson, and Tom Reidy of BRV, who manages the lawn care for Bryant Park in New York City to acquire data on the costs and maintenance practices for natural grass. We gathered further maintenance and cost data from maintenance guides, municipal feasibility studies, and maintenance resources available through the **Sports Turf Managers Association**. We additionally did an assessment of the current academic literature regarding life cycle assessments and health hazards of both natural and artificial turf fields.

Using the collected cost and maintenance data we completed a **cost-benefit analysis** of several prominent varieties of artificial turf and natural grass. The cost model examined the costs of acquisition and maintenance over a 16-year period. Since artificial turf fields typically have a usage lifespan of 8-10 years, and are warrantied for 8 years, the costs were examined for the initial purchase and installation, the re-installation after 8 years, and the maintenance costs for the 16-year period, which is the lifespan of two artificial turf fields. The costs for the natural grass fields were normalized to the 16-year period and modeled based on varying re-sodding schedules. For more detail on the cost model, please see the report submitted to the Green Bay Packers located in **Appendix 1**.

In order to present our findings to the client, we utilized a decisionmaking framework to guide the client to the most sustainable choice. Using the data gathered from our initial stakeholder engagements we developed eight criteria to frame our findings: cost, aesthetics, maintenance effort, durability, environmental footprint, human health impact (real and perceived), public affairs impact, and cultural alignment. Please see **Exhibit 2** on the following page. We worked with our client to weight these criteria and then examine how each surface option scored according to their weighting in order to inform their decision making.

Exhibit 2: Decision Criteria for Turf Assessment

Attribute	Direction	Unit	Goal
Cost over 16-years*	Lower	$	Least costly
Aesthetics	Higher	1-5	A functional, beautiful attraction
Est. Maintenance Effort	Lower	1-5	Minimal impact on existing grounds crew
Durability	Higher	Years before replacement	16 years
Environmental Footprint	Lower	1-5	Minimize water use, Carbon emissions, artificial heat, chemical runoff
Human Health Impact	Lower	1-5	Minimize heat and toxic effects
Public Affairs: Sustainability "wins"	Higher	1-5	A field with a story for TTD Tours, outbound communication
Cultural Alignment	Higher	1-5	Draws the community to the field

Energy-Efficient Lighting Design Data Collection

In order to scope our energy-efficient lighting design analysis and gather relevant data, Sterling Project Development (SPD) connected us with the lead lighting designer for the Titletown Development, **Bob White of Illuminart**, a lighting design firm based out of Ypsilanti, Michigan. Working with Mr. White, we gathered information on municipal outdoor lighting regulations in Green Bay and Ashwaubenon that provided parameters for our energy efficient lighting options. We explored the current market offerings for LED fixtures through online market research and phone calls to vendors.

Additionally, we researched market offerings for motion sensors that would provide energy savings through more efficient control of lighting and HVAC systems. To gather this data, we spoke to sales representatives from leading manufacturers Hubell, Wattstopper, and Enlighted. We obtained data on product specifications in order to find the best options that met the regulatory requirements for the Titletown Development.

As part of our project for Illuminart, we also needed to examine the baseline lighting scenario for the site. The purpose of this was to help Illuminart design lighting intensities for the Titletown Development according to the existing lighting intensities surrounding the project site. In order to achieve this, we visited the Titletown site in April 2016 and used a photometer to measure light intensity. We captured readings on various sites in the parking lot outside Lambeau Field and the surrounding neighborhoods. This data provided Illuminart with the ability to customize efficient outdoor lighting for each side of the development.

Phase II

As our team moved on to Phase II of our project in Summer 2016, we sought out two key groups to inform our development of an organizational sustainability strategy: 1) peer and parent organizations and 2) local stakeholders in the greater Green Bay area.

Peer & Parent Organizations

Our team recognized the importance of connecting with a front office individual within the **National Football League** to understand the League's role with individual teams such as the Packers and their sustainability efforts. Aaron Popkey of the Packers connected us with **Jack Groh**, Director of the NFL's Environmental Program, to discuss his work and the NFL's interactions with teams involving sustainability. Mr. Groh shared his experience leading sustainability efforts for events such as the Super Bowl and Pro Bowl for the past 20 years. He explained that the League, at present, did not serve as a facilitator for sustainability conversations among its 32 teams nor advised them with regards to best practices.

For the above reason, our team sought out leadership from the **Green Sports Alliance** (GSA). Our first point of contact was with SNRE alumna **Dania Gutierrez** (Class of 2015), who shared a number of sports sustainability resources with our team to understand organizations at the forefront of this space. Dania also connected our team with **Justin Zeulner,** GSA Co-Founder and Executive Director, who detailed the current state of sports sustainability and key aspects such as community and fan engagement, the built environment, and partnerships.

After gaining a high-level understanding of national efforts, our team sought out two specific team organizations. First, we spoke with three front office leaders with the **Philadelphia Eagles**: **Ryan Hummel**, Director of Facilities; **Brett Strohsacker**, Public Relations Manager; and **Norman Vossschulte**, Director of Fan Experience. As stated previously, the Eagles are one of the leading sustainability-minded NFL organizations and proved to be a key resource to understand not only the initiatives the Eagles have spearheaded but also how they created a culture of sustainability within the organization and its front office. Second, we engaged **the University of Michigan Athletic Department** (UMAD) to understand organizational sustainability planning and goal setting. Our team spoke with UM Associate Athletic Director **Robert Rademacher**, who shared how the UMAD created its one-page sustainability game plan as well as the department's progress towards its stated initiatives.

Our contacts at the Philadelphia Eagles directed us to their independent sustainability consultant **Lindsay Arell of Honeycomb Strategies**. Through conversations with Ms. Arell, we were able to gather information on best practices for managing organizational sustainability efforts. Lindsay informed us of the **ISO 20121 Event Sustainability Management Standard** as a potential framework to use to guide the Packers' efforts. We adapted this standard to the Packers' interests and organizational barriers in order guide our strategy recommendations.

Local Stakeholder Interviews

Understanding the needs and concerns of those affected by the Packers' actions is critically important to any Packers sustainability initiatives meant to build community resilience. These stakeholder priorities also served as a means for our team to identify and prioritize crucial local and regional economic imperatives of which the Packers must remain cognizant. In the interest of time and in the spirit of gaining buy-in from elected decision-makers, we centered our interviews on positions of economic development and resource protection within local and Wisconsin state government.

To this end, our team spoke with representatives from both the **Land and Water Conservation Department** and **Port and Resource Recovery Office of Brown County**. These meetings helped our team gain a greater understanding of the tri-county landfill rotation, the economic drivers behind landfill management, barriers to switching should the Packers decide to move their waste streams to a more local processing facility, and the role of parking lot reduction in helping the County achieve its goals of reducing nutrient runoff into local water sources.

To better understand the economic needs of residents in Green Bay, we spoke with the Green Bay Economic Development Office. These talks provided a more holistic understanding of the macroeconomic forces affecting the region. Specifically, we learned of local initiatives to increase both high-end and affordable housing in Green Bay and train and retain home-grown business talent.

Summary of Findings

Our group's consolidated recommendations, organized by project phase and discrete initiative within the overall project, are described below.

Phase I

Findings from Phase I of our project encompass two research efforts related to the Titletown Development: "Artificial Turf vs. Natural Turf Analysis" and the "Titletown Energy Efficient Lighting Analysis."

Titletown: Artificial Turf vs. Natural Turf Analysis

Consolidated summary of findings:

Using the criteria outlined in the methods section to weigh the various grass and artificial turf options illuminated two best alternatives: natural grass and NikeGrind turf. NikeGrind had a total cost over the 16-year period of $1.15M, while the natural grass option had a total cost of $1.7-2.9M depending on the resodding frequency. The natural grass had higher aesthetic rating when re-sodded more frequently. In order to maintain that aesthetic, however, natural grass had much higher maintenance efforts required than the NikeGrind option. NikeGrind ranked higher on durability due to its ability to withstand frequent use without needing time to recover. The natural grass option has a lower environmental footprint than artificial turf surfaces and can even provide ecosystem services.

Traditional rubber crumb artificial turf surfaces have higher carbon footprints and the ecotoxicity of rubber leachates has long been recognized. Outside the company, there have been no lifecycle assessments performed on NikeGrind surfaces, so they were assumed to be similar to traditional rubber crumb artificial turf; however, there may be lower impacts due to the use of worn-out athletic shoes, as well as due to Nike's stringent material restrictions for its shoe rubber. While there have been no current studies on the health impacts of NikeGrind fields, NikeGrind's material composition standards additionally alleviated the associated potential health risks as compared to traditional rubber crumb artificial turf. The NikeGrind option provided a rich sustainability story to be communicated to Titletown users, however the natural grass better aligned with the Wisconsin conservation values and the outdoors. **Exhibit 3** shows the output of the analysis.[36]

[36] Artificial Turf vs. Natural Grass Analysis. See Appendix 1.

Exhibit 3: Turf Assessment Output

Attribute	Direction	Natural Grass	Nike Grind
Cost over 16 years	Lower	*$1,411,851	$1,158,325
Aesthetics	Higher	5	3
Est. Maintenance Effort	Lower	4	2
Durability	Higher	2	4
Environmental Footprint	Lower	2	3
Human Health Impact	Lower	2	UNK
Public Affairs: Sustainability "wins"	Higher	4	5
Cultural Alignment	Higher	5	4

Our research and stakeholder interviews led us to determine that the tradeoffs in this decision revolved between two crucial variables which were functions of other, less-heavily-weighted decision variables valued by the Packers. These key variables were long-term total cost of ownership and environmental and human health impacts. Artificial turf was the winner when the selected surface needed to be the most-optimal composite of high durability and medium maintenance. Natural grass was the winner when the chosen field needed to have a low upfront cost and minimal negative environmental and human health impacts. Of the artificial turf options we researched, only the NikeGrind turf offered an option not-yet-linked to human illness, since this turf is comprised of ground up shoes instead of discarded tires.

Recommendations based on findings:

After narrowing down the turf options with the Packers decision-making team based on our compiled analysis of the key decision criteria, we recommended installing an artificial turf field with NikeGrind infill for the Titletown playfield. NikeGrind was the least negatively impactful artificial turf option for the environment and human life that satisfied the field's durability requirements. At the same time, we acknowledged that a natural grass field would have been the most environmentally- and human-health-friendly option overall, and a natural grass field better aligns with the spirit and values of Wisconsin that the development team intends to evoke in Titletown.

Please refer to **Appendix 1** for the complete set of recommendations and analysis provided to the Green Bay Packers .

Titletown Energy Efficient Lighting

Consolidated summary of findings:
The new Titletown District had developers and construction contractors planning the development. *Illuminart*, a firm based out of Ypsilanti and run by Robert White, led the lighting design and implementation within the project. We got in touch with Mr. White to work on energy-efficient lighting as well as studying the baseline lighting competition in the development area. Our project objectives were the following:

1. Study Ashwaubenon District Urban Design Policy to ensure all lighting regulations are met in the Titletown District
2. Study the baseline lighting scenario around the development area
3. Research motion sensor products that are energy efficient and control both lighting and HVAC

Ashwaubenon Village Urban Design Policy affected the Titletown Development. All new construction projects must abide by the design regulations that are set for the District and these regulations vary from city to city. The village of Ashwaubenon also has a set of regulations developed specifically for outdoor “sports and entertainment” projects being constructed in this region. Regulations also include rules defining the types of lighting allowed, permitted lighting structures, and permissible intensity-levels of light at various locations within the site. We conducted research to have a thorough understanding of these rules and studied whether the lighting specifications developed by Illuminart met the regulations.

Our baseline lighting study involved analyzing the existing lighting competition and light pollution in-and-around the site area. Light pollution refers to unnecessary and excessive artificial light while light competition refers to a lighting strategy to make a specific brand more visible or prominent as compared to other commercial spaces around your site area. Both light pollution and light competition can be analyzed by conducting a baseline lighting study. We used a photometer to record light intensity readings on all four sides of the site. Titletown District is surrounded by the following on each of the four sides, depicted in **Exhibit 5** below:

- Lambeau Stadium (Boundary 1)
- Residential area (Boundary 2)
- Major road (Boundary 3)
- Phase 2 of Titletown Development (Still in planning phase) (Boundary 4)

Since the site area reserved for Phase 2 of the Titletown Development was still in the planning phase, there are no sources for lighting on this side. We sampled and recorded existing light intensity levels on all three other sides. The Lambeau Stadium parking lot faces Boundary 1 of the Titletown Development. This parking lot has a number of high intensity sodium lamps (yellow light); hence, this side had the highest photometer readings. The residential area was adequately lit and did not have any commercial lighting on the street. Therefore, the design

team needed to keep this in mind to ensure that the lighting does not excessively increase the existing intensity for the residents during the late evening and night hours on Boundary 2.

Exhibits 4 and 5 show the photometer readings along with the location details of where the observations were taken:

Exhibit 4: Photometer Readings at Project Site

Lambeau Field Parking Lot, Roadside Verizon gate, Southwest side walking east

A. 2.4 under street side light
B. 2.3 mid way
C. 3.37 under tall double light, stadium side
D. 1.82 midway between the two stadium side tall lamps
E. 2.02 center point
F. 1.38 Midway point between streetside lamps
G. 2.07 Where north streetside lamp should be
H. 2.91 midway between where north streetside lamp should be and north stadium side lamp
I. 3.47 under north stadium side lamp
Note that street side lamps are much smaller light output than stadium side

Titletown site and Brookwood Drive

J. 0.3 middle of titletown
(Going straight up)
K. 0.62 middle of titletown (facing lambeau)
L. 0.021 middle of titletown (facing away from lambeau)
M. 0.013 corner of Brookwood and Orrie
N. 0.018 midway between corner of Brookwood and Orrie
O. 0.182 streetlight

Exhibit 5: Photometer Readings at Titletown Development Project Site

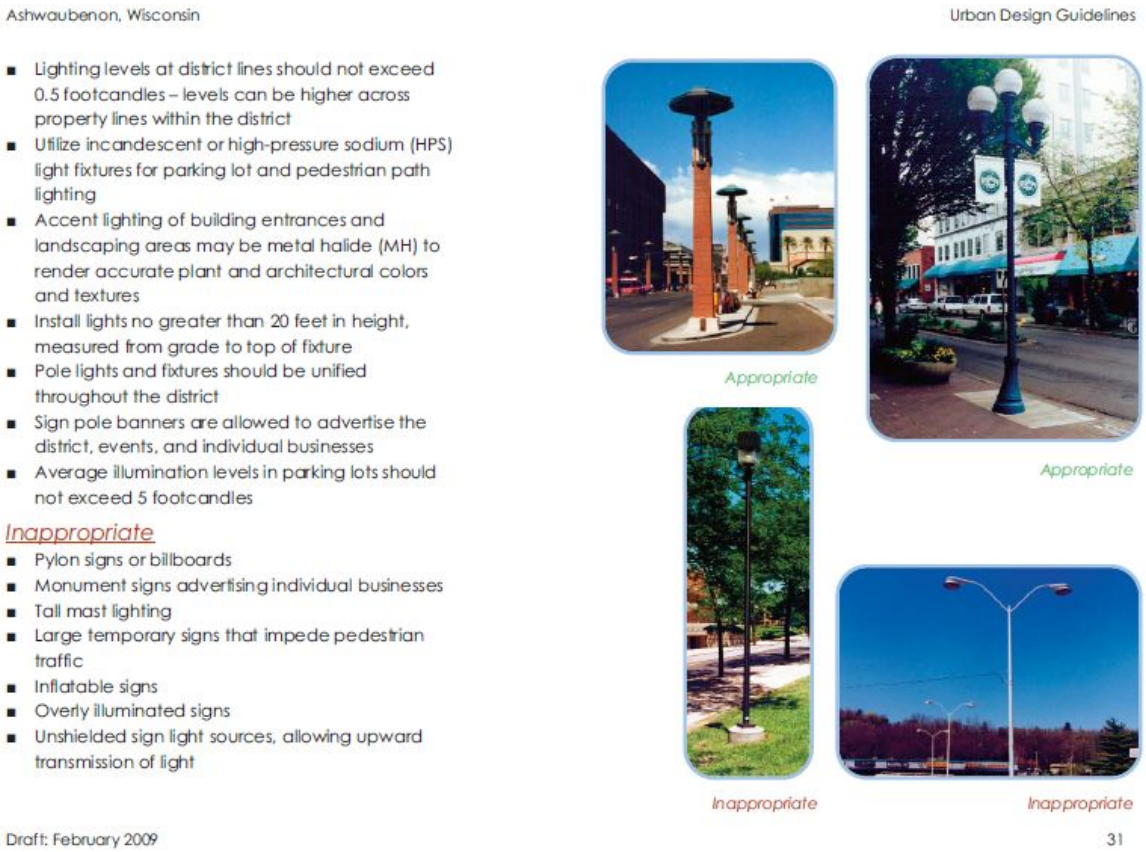
Note: Markers M, N, O represent Boundary 2 (housing/residential area). Markers L, J, K represent Boundary 3 (major road/highway).

In addition to our above work, we also conducted market research for motion sensors. Illuminart's lighting project for the Packer's involved lighting design as well as ensuring that energy consumption was low by using more efficient products. To this end, we conducted market studies to identify outdoor motion sensors that met the specifications given by Illuminart while also helping to conserve energy. The research was based on specifications given by Illuminart in terms of wattage, product types, voltage, and choice of brand requirements.

Recommendations based on findings:

Our urban lighting design policy recommendations are as follows. The guidelines that are required by Ashwaubenon District for outdoor "sports and entertainment" projects are stringent and regulated to ensure common design themes are used across the District. The intensity of lighting is capped at 5-foot candles for parking areas. Advertising on the lighting poles are also regulated. **Exhibit 6** provides an overview of Ashwaubenon County lighting regulations related to lighting fixture design.

Exhibit 6: Lighting Design Policy in Ashwaubenon, Wisconsin[37]



[37] Urban Design Guidelines for the Sports & Entertainment and the Village Center Districts. Accessed at http://www.ashwaubenon.com/Portals/Ashwaubenon/Departments/Finance/Documents/UrbanDesignGuidelines.pdf?ver=2010-02-03-095112-000 on April 14, 2016

The urban design policy for lighting was not just restricted to the height and types of lights that can be used but extended to the design of the parking lots as well. Given that parking lots are outdoor spaces where security is a concern, we looked at the design policy for parking structures. We studied the table of regulations for the type of lighting and the spacing required in parking and pedestrian areas. **Exhibit 7** provides an overview of lighting regulation based on level of activity.

Exhibit 7: Lighting Regulation Based on Level of Activity[38]

Open parking facilities.General Parking and Pedestrian Area	Vehicle Use Area (Driveway)					
Level of Activity	Minimum Foot-candles* On pavement	Maximum Uniformity Ratio (Avg:Min)	Maximum Watts*** - Sq. Ft. Lighting Load**	Minimum Foot-candles* on pavement	Maximum Average Foot-candles on pavement	Maximum Uniformity Ratio* (Avg:Min)
High	0.6 fc	5:1	0.12	0.67 fc	2.5 fc	5:1
Medium	0.4 fc	5:1	0.10	0.33 fc	1.5 fc	5:1
Low	0.2 fc	5:1	0.08	0.125 fc	1.0 fc	5:1

Our motion sensor product recommendation were narrowed down to the following products. Images of each can be found in **Appendix 2.2**.

- Wattstopper Low voltage outdoor motion sensor
- Wattstopper EW line voltage outdoor motion sensors
- Lutron outdoor daylight control package
- Lutron wireless Radio power saver: Occupancy sensor
- Hubbell M series motion sensors
- Hubbell automated outdoor lighting control systems

[38] Accessed at http://www.ashwaubenon.com/Portals/Ashwaubenon/2015-Chapter%2017%20Zoning%20Code-use_d.pdf on April 15, 2016

Phase II

Findings from Phase II of our project were comprised of findings from our engagements with stakeholders and peer organizations.

Findings from engagement with stakeholders and peer organizations

Consolidated summary of findings:

Our team identified helpful tools from peer organizations to help the Packers develop an organization-wide sustainability strategy. While a deep understanding of sustainability issues and adaptive measures are important for achieving sustainability goals, many organizations that are just beginning to grapple with sustainability do not have the capability to design and implement sustainability measures immediately. Importantly, preliminary actions (including goal-setting and process management) can often set up these organizations for success. During the development of our recommendations for the Packers, we consulted the Philadelphia Eagles and the University of Michigan Athletic Department and evaluated two key tools that could help facilitate these kinds of preliminary actions within the Packers organization, as outlined below.

The **University of Michigan Athletic Department (UMAD)** is organized and intentional about its sustainability initiatives. The development of a "1-Pager" has enabled the UMAD to accomplish two important and often elusive things related to its organizational sustainability strategy: alignment and focus.[39] First, the UMAD sustainability activities are intentional and aligned with the mission of the organization and the needs of its stakeholders. The process of aligning the mission of the organization and the needs of its stakeholders with the UMAD sustainability strategy has led to impactful sustainability efforts and buy-in from the stakeholders.[40] Second, distilling the universe of possible sustainability issues into a structured matrix has focused the UMAD sustainability activities.[41] The UMAD has organized its sustainability activities according to sustainability issue area, level of effort, and short- versus long-term initiatives.[42] This process can lead to more effective deployment of resources and allow organizations to achieve milestones even from the infancy of their sustainability efforts.

Philadelphia Eagles consultant Lindsay Arell suggested a number of important elements of any attempt to institutionalize sustainability actions within an organization. While the Eagles differ from the Packers in that they have had sustainability initiatives in place for some time and have clear buy-in and direction from high-level executives in the organization, Ms. Arell noted that a baseline assessment of an organization's sustainability processes and policies is critical to effective sustainability strategy development.[43] In addition, the development of "Microgoals"

[39] Personal communication with Robert Rademacher. University of Michigan Athletic Department. August 3, 2016.
[40] University of Michigan Athletics. Sustainability 1-Pager. See Appendix 3.
[41] University of Michigan Athletics. "Sustainability." Accessed at http://www.mgoblue.com/sustainability/ on April 16, 2017
[42] University of Michigan Athletics. "Sustainability." Accessed at http://www.mgoblue.com/sustainability/ on April 16, 2017
[43] Personal communication with Lindsay Arell on October 27, 2016.

lubricates the process of initiating sustainability actions. According to Ms. Arell, with large organizations tracking progress made on microgoals can facilitate an environment of continuous improvement. This can be helpful for large organizations who have resource constraints. Monitoring and goal setting can create a framework for action on sustainability, such that an organization is compelled to make future commitments to sustainability, even at a time when the organization cannot dedicate resources to sustainability.[44] Ms. Arell asserted that implementing a process for monitoring and goal setting can even be impactful in organizations where motivation is lacking.

Recommendations based on findings:

Following conversations with the Packers' Aaron Popkey and Ed Policy, our team identified a need for the Packers to develop organizational-wide sustainability goals to allow the organization to focus its future sustainability efforts around defined organizational priorities. We determined that the Packers would benefit the most from a concise document containing overarching sustainability priorities.

Utilizing the basic structure of the University of Michigan's Athletic Department "1-Pager" and information gained from numerous stakeholder interviews defined in the above Research Methods section, our team first created four sustainability focus areas for the Packers. We then developed long-term organizational goals as well as more short-term initiatives around each of the four focus areas.

The four focus areas and subsequent goals and initiatives are listed below. The complete 1-pager can be located in **Appendix 3**.

1. **Create an Active Network for Sustainability Engagement**
    a. *Long-Range Goals*
        - Institutionalize a culture of sustainability through ISO 20121 or other process framework
        - Integrate knowledge of the executive board and other stakeholders to advance sustainability initiatives
        - Create systems of measuring sustainability outcomes (and financial outcomes thereof)
    b. *Initiatives*
        - Survey the Executive Committee, Board of Directors, and Players for sustainability skills, business interests that could benefit from pooling knowledge
        - Create Sustainability Council based on skilled/ interested board members
        - Become a member of the Green Sports Alliance
        - Establish long-term, planned, sustainability internship/ iterative project relationship with UWGB

[44] Personal communication with Lindsay Arell on October 27, 2016.

2. **Efficient Resource Management - Game Day and Every Day**
    a. *Long-Range Goals*
        - Leverage and refine existing Packers waste programs, and involve external stakeholders such as UWGB
        - Advocate for long-term recycling and composting facilities in the Green Bay area with local stakeholders
        - Incorporate energy and water efficiency reviews into annual ISO processes
    b. *Initiatives*
        - Implement a compostable waste diversion program
        - Identify and implement cost-saving or cost-neutral energy and water efficiency projects
        - Conduct annual audits of day-to-day and game day recycling and composting operations at all facilities

3. **Economic Prosperity in Green Bay**
    a. *Long-Range Goals*
        - Develop community of businesses in the Titletown area to spur economic growth
        - Ensure Green Bay's draw as an attractive area for young professionals
        - Choose local partnerships whenever economically feasible and programmatically aligned
    b. *Initiatives*
        - Leverage sustainability initiatives to create local economic activity
        - Create partnerships with local businesses to implement Packers sustainability initiatives
        - Maximize sourcing of locally produced items, with a focus on food
        - Examine opportunity to fund local innovative ventures in green space through seed grants

4. **Community Education and Awareness**
    a. *Long-Range Goals*
        - Engage staff, fans and community members as active participants in sustainability
        - Outwardly demonstrate our commitment to sustainability through education and marketing
        - Facilitate conversations with community groups and leaders to advance sustainability in the region

    b. *Initiatives*
        - Provide sustainability training and education, customized to specific job roles
        - Solicit corporate partnerships for sustainable initiatives
        - Highlight sustainability efforts on Packers' website and at games on video boards
        - Leverage Titletown infrastructure to educate public on green efforts

Next Steps

Through our 16-month engagement with the Green Bay Packers, we were able to produce two analyses related to the Titletown Development (Phase I) as well as an overarching direction for their future sustainability-oriented actions in the form of an organizational sustainability goals 1-pager (Phase II). We have also connected Packers leadership with key individuals from our stakeholder engagement process. Our team circled back with sustainability consultant Lindsay Arell to facilitate a partnership with the Packers for an upcoming presentation during the June 2017 Green Sports Alliance Summit to be held in Sacramento, California. Ms. Arell is intending to use the Eagles and Packers as examples of community resiliency efforts and well as the ISO 20121 process helping teams both experienced and nascent in their sustainability journeys.

As our SNRE team ends its formal engagement with Packers in April 2017, we have sought to identify some concrete, actionable items for the Packers to begin implementing sustainability into their organization based on our work. On multiple occasions, Packers leadership has expressed a desire to begin to delve into sustainably-focused work starting with near-term "long-hanging fruit." Looking ahead, we believe the Packers would benefit from pursuing the next steps laid out below, in order to begin their journey of creating a culture of sustainability within the organization to pursue the goals and initiatives included in our organizational sustainability goals 1-pager. These next steps include:

1. **Establishing a Sustainability Point-of-Contact**: At present, sustainability efforts are placed in the work portfolio of the Packers' Director of Public Affairs, Aaron Popkey. Our team believes that Green Bay Packers leadership should examine this current status and determine if this in fact the best department in which the role should sit, and if another individual would be better suited for the role given Mr. Popkey's breadth of work.

2. **Reinvigoration the Packers Green Team***:* In recent years, the Packers Green Team has had little to no activity, with some former Green Team members stating it may no longer formally exist.[45] We believe that reforming the Green Team is a crucial step to creating a culture of sustainability across the organization and to assist in the implementation of sustainability-focused initiatives. Based on learnings from peer organizations such as the Philadelphia Eagles, we believe that quarterly Green Team meetings will allow the necessary amount of conversation and face-to-face interaction focused on sustainability issues to achieve momentum and progress.

3. **Leverage Executive Committee and Board of Directors**: Successful peer organizations such as the Eagles have buy-in regarding sustainability from leaders at the very top of the organization. Unlike their peers, however, the Packers have a unique organizational leadership structure which gives authority to a wider group of individuals than most professional sports teams governed by a single owner or family ownership.

[45] Personal communication with Ted Eisenreich. The Green Bay Packers. February 1, 2017.

For this reason, the Packers Green Team and/or the sustainability point-of-contact would benefit from conducting a poll of interest in sustainability issues among members of the Green Bay Packers Executive Committee and Board of Directors. This will allow the Packers to identify sustainability “champions” that can assist and spearhead initiatives that may overlap with their individual business expertise or professional endeavors.

4. **Integrate the ISO 20121 Process into First Projects***:* Once the groundwork internally is completed regarding the first three steps, Packers leadership will be well suited to begin implementing initiatives included in the organizational sustainability goals document. To do so, they should integrate the ISO 20121 Event Sustainability Management Standard into the first projects to establish a systematic process into their work in this space.

Overall, the Packers have a unique opportunity through the Titletown Development to catalyze their sustainability efforts, engage local and national stakeholders in the process, and create a lasting culture of sustainability that can benefit the organization financially, the fabric of the community, and the environment in northeast Wisconsin.

Appendices

Appendix 1: Artificial Turf vs. Natural Grass Analysis
Appendix 2: Titletown Sustainable Options for Lighting
Appendix 3: Packers' Organizational Sustainability Goals 1-Pager

Appendix 1: Artificial Turf vs. Natural Grass Analysis
Submitted to the Green Bay Packers on April 30, 2016

REPORT: ARTIFICIAL TURF VS. NATURAL GRASS
PREPARED BY: UNIVERSITY OF MICHIGAN,
SCHOOL OF NATURAL RESOURCES & ENVIRONMENT

EXECUTIVE SUMMARY AND DECISION FRAMEWORK

Recommendation:

We recommend installing an artificial turf field for the Titletown playfield, specifically an artificial turf field with "NikeGrind" infill. Artificial turf's durability allows for intensity of usage that is in line with our understanding of the intended usage of the field. Furthermore, NikeGrind is the most sustainable artificial turf option that satisfies the field's durability requirements. At the same time, we acknowledge that a natural grass field is the most sustainable option overall, and a natural grass field better aligns with the spirit and values of Wisconsin that the development team intends to evoke in Titletown.

We also recommend that the development team consider restricting tailgating activities on the playfield. Tailgating on the playfield poses complications related to food and beverage spills (which are not covered by warranty) and other damage to the field. These risks may outweigh the value of tailgating at the site, from a revenue and user-experience perspective.[46]

Overview:

This analysis of natural grass and artificial turf surfaces supports ongoing planning efforts for the main field in the Titletown development adjacent to Lambeau Field in the Village of Ashwaubenon, WI. The report evaluates the tradeoffs presented when choosing between natural grass and artificial turf, specifically regarding cost, durability, maintenance, environmental impact, health effects, and expected usage. Artificial turf has come a long way since its inception in the 1960s. There are now several varieties of turf products on the market for use in recreation and sports, both indoors and outdoors. Artificial turf is composed of a supportive underlayer, plastic artificial grass blades, and infill. While the composition and performance of the underlayer and blades is constant, the attributes of different types of infill vary. This report explores three artificial infill options in detail: traditional rubber crumb fill, a new option called NikeGrind or EcoGrind, and an alternative silica sand material called "Envirofill."

Those working on the design and development of Titletown have already identified two fine fescue grass blends with low water requirements: Black Beauty and RTF Water Saver. Fine fescues are of particular interest for their drought tolerance (low watering requirements) and

[46] As a comparison, a natural grass surface would require further limitations on the usage of the field (over and above restricting tailgating) to allow for necessary recuperation periods for the grass.

durability. Sod installation costs exceed the costs of seeding grass; however, we evaluate sodded grasses in this analysis because sod takes much less time than seeded turf to reach optimal grass height and durability.

Over the life of the playfield, **artificial turf is more cost-effective** than natural grass. While artificial fields require a larger initial investment than a natural grass field, resodding and other maintenance costs associated with natural grass turf outpace maintenance costs of artificial turf. The costs associated with each field vary depending on use and maintenance patterns. We examined the costs of acquisition and maintenance over the typical useful life of artificial turf fields. Costs for the natural grass fields were normalized to the same useful life.

Durability depends on factors such as the intensity of usage, local climate, and desired appearance of the field surface. With regular and proper maintenance, modern artificial turf fields can last 8-10 years, and reducing the intensity of usage can extend the life of artificial turf, though not indefinitely.

Heavily used natural grass fields can last up to ten years with proper maintenance; however, higher usage will require more frequent resodding. Minor damage to the field from lateral movement or shearing can occur and is repaired by planting grass seed or re-sodding damaged patches.[47]

Maintenance of fields constructed with artificial turf is required regularly, and is typically less burdensome than natural grass turf maintenance. Both field types require regular maintenance schedules, with tasks differing by daily, weekly, and yearly schedules. Rainfall or watering an artificial turf surface are the best methods of cleaning an artificial field. Cleaning the field is required after events with high foot traffic and high potential for contamination. For winter management, snow and ice do not harm artificial turf, and snow can be removed or left to melt.

Natural grass requires more regular maintenance than artificial turf, including watering, mowing, soil care and fertilization, disease and weed control, and repair and re-sodding damaged patches. For the fine fescues that make up the Black Beauty and RTF mixes identified by the Titletown team, maintenance is low relative to more traditional grass species, like Kentucky bluegrass.[48,49,50] Required watering is low to moderate. Fescues need fertilizer application only twice per year.

The main **human health** concerns for artificial turf fields are associated with the use of a rubber crumb infill made from recycled tires. These concerns are related to exposure to organic

[47] Personal communication with Tom Reidy. Biederman Redevelopment Ventures. April 15, 2016.
[48] LawnCare.org. Winter Lawn Care Tips." Accessed at http://www.lawncare.org/winter-lawn-care-tips/ on April 13, 2016
[49] Turfgrass Producers International. "Grass Varieties." Accessed at http://www.turfgrasssod.org/pages/consumer-resources/types-of-grasses on April 13, 2016
[50] Absolutely Bushed. "When to Re-seed or Re-sod Your Lawn." January 28, 2011. Accessed at http://absolutelybushedlandscaping.blogspot.com/2011/01/when-to-re-seed-or-re-sod-your-lawn.html on April 13, 2016

compounds and heavy metals within the rubber crumb, which may occur through skin contact, ingestion, and the inhalation of associated volatile organic compounds (VOCs).[51] There are still limited studies on the health impacts of Envirofill and NikeGrind infills. Nike, however, states that their infill meets their Restricted Substances List (RSL) standards, and the material is routinely tested against safety standards in an independent lab.[52] There are also concerns about exposure to high surface temperatures that artificial turf surfaces can reach on warm, sunny days. Natural grass fields have minimal human health considerations.

With regard to **environmental impact**, artificial turf fields have significantly higher greenhouse gas emissions across their entire life cycle. While there is some uncertainty regarding the exact magnitude of greenhouse gas emissions associated with natural grass fields, it is clear the natural grass fields have significantly lower life cycle emissions than an artificial turf field.

While studies of ecosystem impacts are inconclusive, the *ecotoxicity* of leachate from rubber tires (especially used tires) has long been recognized. The drainage from artificial turf fields with a rubber crumb from recycled tires has the potential to be harmful to "the growth, survival, and reproduction of aquatic plants...fish, and amphibians" even at low concentrations.[53]

The use of fertilizer in natural grass fields releases nitrogen and phosphorous into the environment, which can lead to eutrophication in water sources. Proper management of natural grass fields can reduce the potential environmental impacts of using fertilizer.

Unlike artificial turf, natural grass fields can also provide ecosystems services such as carbon sequestration, biodiversity, and cooling effects. Natural grass supports biodiversity by providing habitat for macroinvertebrates (insects, worms, etc.), which are fed on by birds and other animals. Grasses provide a cooling effect through transpiration and dissipating radiant heat in urban areas. They can even reduce the energy inputs required for the cooling of adjacent homes and buildings.[54]

SURFACE OPTIONS

Natural Grass

Grasses are typically categorized as warm season species and cool season species. Cool season grasses are more common in Wisconsin, as they grow better than warm season grasses during the cool, "shoulder" seasons. All else equal, cool season grasses withstand the cold

[51] Cheng, H., Hu, Y., & Reinhard, M. (2014). Environmental and health impacts of artificial turf: a review. *Environmental science & technology*, *48*(4), 2114-2129.
[52] Alba, M. and Monahan, K. (2014, October 23). High School Changes Plans for Artificial Turf Field. *NBC News.* Accessed at http://www.nbcnews.com/news/investigations/high-school-changes-plans-artificial-turf-field-n232686 on April 10, 2016
[53] Cheng, H., et. al
[54] Beard, J. B., & Green, R. L. (1994). The role of turfgrasses in environmental protection and their benefits to humans. *Journal of Environmental Quality*, *23*(3), 452-460.

better than warm season grasses. Warm season grasses tend to require less water.[55] The growing season in Northern Wisconsin for cool season grasses is May 1—June 15 and July 15—August 10.

The most commonly used grass species in Wisconsin (primarily cool season grasses) include Kentucky bluegrass, fine fescue, and perennial ryegrass. Fine fescues are of particular interest for their drought tolerance, low water requirement, and durability. Those working on the design and development of Titletown have already identified two fine fescue grass blends with low water requirements: Black Beauty and RTF Water Saver.

Sod installation costs exceed the costs of seeding grass; however, we evaluate sodded grasses in this analysis because of the shorter time from installation to optimal grass height and durability associated with sod. In addition, in areas where wind and birds can interfere with laying seeds, sod is preferable.

Artificial Turf

Artificial turf has come a long way since its inception in the 1960s as a simple green carpet of nylon fibers. There are now several varieties of turf products on the market for use in numerous sports and recreation purposes in both indoor and outdoor settings. Most synthetic turf systems include a drainage layer, a multi-layered backing system, and "grass" blades that are then infilled with a granular filler that provides necessary uniformity, resiliency and stability to the turf surface. Some turf systems will also include a pad or elastic layer underneath the playing surface for better performance and to reduce compaction. Artificial turf grass blades are typically manufactured from oil-derived substances such as petroleum-based polyol; however, grass blades comprised of soy-based components have also recently entered the market and have been installed at academic institutions such as UCLA.[56]

Below is a description of a few of the most common artificial turf products with particular focus on the most applicable types for the Titletown Project. After speaking with several vendors, only infill-based products were considered as infill artificial turf best meets the needs of the Titletown playfield.

- **Rubber (crumb rubber)** - Crumb rubber is the most commonly used infill on the market today. It is derived from scrap car and truck tires that are ground up and recycled. Vendors will often sell a hybrid rubber/sand mixture to maximize ideal performance, with rubber comprising 50%-100% of the infill.
- **Sand (silica) infill** - High quality silica sand can also be used as a standalone infill, though is less common than crumb. Sand tends to compact, so it is often coupled with a pad underneath the surface to provide more bounce and cushion. Coated sand products

[55] United States Department of Agriculture. "Five Keys to Successful Grass Seeding in Wisconsin." May 2007. Accessed at http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/mipmcbr7265.pdf on April 14, 2016

[56] AstroTurf. "Soy-based Infills." Accessed at http://www.astroturf.com/tag/soy-based/ on April 13, 2016

such as EnviroFill have also arrived on the market in recent years, which provide antimicrobial protection and durability to the infill.

- **TPE Infill** - Thermoplastic elastomer (TPE) infill is a non-toxic, heavy metal free option for infill that also has the benefit of being 100% recyclable and reusable as infill when the field is replaced. TPE infills have been installed in over 500 fields worldwide in the past 10 years.[57]
- **Cork** - Cork infill is relatively new to the market, such as FieldTurf's Purefill line. A fully organic material, cork has proven heat reduction and good compression characteristics. However, there are additional maintenance requirements for a cork field and some migration of infill may occur with use. There are also cork composites on the market, which are comprised of a combination of natural cork, polyethylene and elastomers.
- **NikeGrind/EcoGrind** - Utilizing a rubber mixture from running shoes, several turf companies have debuted alternative rubber infills, such as NikeGrind from AstroTurf and EcoGrind from FieldTurf. This type of system utilizes a pad underneath the surface to enhance performance. While the infill is available in a uniform dyed green color, it is also available as in a multi-color option.[58] This latter "confetti" infill option provides a unique look to the field and helps in relaying the unique sustainability story of the reused ground-up shoes. This infill provides a similar playing experience to a sand/rubber field. Supply is limited as it is a post-industrial recycled material.

COST

The costs of the different fields vary depending on use and maintenance patterns. This cost model examined the costs of acquisition and maintenance over a 16-year period. Since artificial turf fields typically last 8-10 years, and are warrantied for 8 years, the costs were examined for the initial purchase and installation, the re-installation after 8 years, and the maintenance costs for the 16-year period, which is the lifespan of two artificial turf fields. The costs for the natural grass fields were normalized to the 16-year period.

The artificial fields require a larger initial investment: the traditional rubber crumb turf costs approximately $647,000, while the NikeGrind system costs approximately $665,000 and the Envirofill system costs approximately $1.1 million. These costs are based on estimates from various vendors and could vary slightly. In contrast, a natural grass field costs approximately $330,000 to purchase and install. See **Figure 1**.

Figure 1: Initial Purchase and Installation

Rubber Crumb Turf	NikeGrind Turf	Envirofill Turf	Natural Grass
$647,050	$665,875	$1,136,500	$331,200

[57] Fieldturf. "Alternative Infill Comparison." Accessed at http://www.piedmont.k12.ca.us/forms/turf/fieldturf/FieldTurf_Flyer_Alternative_Infills.pdf on April 14, 2016
[58] Personal conversation with Rich Jordan. AstroTurf. April 15, 2016.

The maintenance for all of the artificial turf systems was found to be similar; therefore, maintenance costs were only modeled for artificial fields as a general category. The maintenance costs for natural turf were calculated separately from the costs of re-sodding.[59] See **Figure 2.**

Figure 2: Annual Maintenance Costs

Artificial Turf	Natural Grass (without re-sodding)
$17,369	$17,755

The biggest cost differences come from the re-sodding of a natural grass field. The amount of re-sodding needed depends on use patterns. The cost model was built on an assumption that re-sodding would require the replacement of an entire field, with the cost of $3 per square foot, for a total cost of $225,900. A cost schedule for re-sodding annually, every two years, and every three years is provided. **See Annex 1**.

Over a 16-year period, using a 2.3% inflation rate and a 6% discount rate, the Rubber Crumb and NikeGrind fields are fairly comparable in costs. The natural grass fields are more expensive than the Rubber Crumb and NikeGrind artificial turf fields, and the magnitude of difference is dependent on the re-sodding schedule. The total costs of all field systems over a 16-year period are seen in **Figure 3**.

Figure 3: Total Costs over 16 years

Rubber Crumb Turf	NikeGrind Turf	Envirofill Turf	Natural Grass Re-sodding annually	Natural Grass Re-sodding every 2 years	Natural Grass Re-sodding every 3 years
$1,131,000	$1,158,325	$1,841,463	$2,978,301	$1,719,152	$1,355,129

The fields were priced without any logos or other field markings. On artificial turf a standard logo can add an additional $10,000-20,000 onto the acquisition cost. A complete list of cost assumptions can be found in **Annex 2.**

[59] Sod installation costs exceed the costs of seeding grass; however, we evaluate sodded grasses in this analysis because of the shorter time from installation to optimal grass height and durability associated with sod. In addition, in areas where wind and birds can interfere with laying seeds, sod is preferable.

DURABILITY

Durability is a relative term and is dependent on factors including the required appearance of the field surface, intensity of usage, usage patterns, and local climate.

Artificial Turf

With regular and proper maintenance, modern artificial turf fields can last between eight and 10 years. Leading manufacturers of artificial turf such as FieldTurf, SporTurf, and AstroTurf offer five and eight-year warranties for their products. Maintenance staff should pay attention to field infill levels and possible migration of infill due to recreational play or plowing during winter weather.

Intensity and frequency of activities - Artificial turf can take a beating compared to natural grass surfaces, as more hours of use can occur per year. Even when it is not used for competitive athletic events, artificial turf can handle a significant amount of foot traffic; however, proper maintenance is crucial for the surface's long-term health.

Appearance - The appearance of artificial turf will vary only slightly over time. In extremely sunny environments, the color of the grass can fade; this is not expected to happen in Ashwaubenon. Additionally, the incorporated logos and field markings will maintain the same design, presumably, for the life of the field.

Usage patterns are heavily reliant upon local weather conditions and permitted activities on the surface. If grills and heat sources are prohibited from an artificial field, it can reasonably be inferred that fewer fans will utilize the field on cold game days, due to a lack of access to warm food and heat sources. This effect, in some sense, as well as the effects of snow cover, neutralize some of the benefit of having an artificial field available at all times for use.

Natural Grass

Natural grass can last indefinitely in theory, though practitioners have stated that nicely-kept professional use lawns should last at least 10 years.[60] Aerating or seeding the field can extend the life of the field before it needs to be re-soiled and re-sodded.[61]

During the first 4-6 weeks after sodding, usage of the field should be heavily restricted. Once sod has solidly taken root (within 4-6 weeks of sodding), minor damage to the field from lateral movement or shearing can still occur. With proper repairs (seeding or re-sodding damaged areas, restricting use in these areas while grasses recover) a grass lawn can continue to grow without issue.

[60] Personal communication with Tom Reidy. Biederman Redevelopment Ventures. April 15, 2016.
[61] Green Blade Lawn Care. Accessed at http://www.greenbladewinnipeg.ca/lawn-life-span/ on April 17, 2016.

MAINTENANCE

Artificial Turf

Fields constructed with artificial turf require regular maintenance schedules, with tasks differing by daily, weekly, and yearly timescales. Maintenance schedules will also vary based on programming and use patterns. After each day's use, the field should be cleared of any trash or debris and checked for distribution and condition of infill of the heavily played areas. On a weekly basis, the surface of the field should be brushed with a static (non-rotary) double brush including simultaneous vacuum devices to redistribute the infill, maintain vertical fibers, and a level playing "use" field. Each month, maintenance staff should check infill levels, seams, and inlaid lines, and report any potential failures or concerns to the manufacturer. Finally, at least once a year a full grooming session should take place involving brushing (rotating unit), vacuuming, de-compacting, and grooming (static brush) of the field surface.[62] This annual or biannual maintenance is performed by a professional maintenance company, most often the company that provides installation. Various maintenance packages are available depending on usage types.

Rainfall or watering an artificial turf surface are the best ways an artificial field can be cleaned. Rain gently removes the turf fibers of dust, pollen and airborne pollutants. In addition to natural rainfall, an occasional water flush is beneficial to soak and cleanse an artificial turf system. On hot weather days, artificial turf is also watered once or twice during the day to cool the surface for athletic use.

For winter management, snow and ice do not harm artificial turf and generally can be left to melt without any assistance. Snow removal is possible either by utilization of a rotary brush, where the brush is not set to dig into the turf surface, or other snow removal mechanisms attached to an approved light vehicle.

Natural Grass

For the fine fescues that make up the Black Beauty and RTF mixes identified by the Titletown team, maintenance is low relative to more traditional grass species, like Kentucky bluegrass.[63, 64, 65]

- **Water Needs -** Low to moderate. Water thoroughly (at least 1 inch) once or twice a week during summer conditions. Species exhibit summer dormancy in drought conditions

[62] SporTurf. “Taking Care of Your Artificial Turf: Infill.” PDF Manual.
[63] LawnCare.org. Winter Lawn Care Tips.” Accessed at http://www.lawncare.org/winter-lawn-care-tips/ on April 13, 2016
[64] Turfgrass Producers International. “Grass Varieties.” Accessed at http://www.turfgrasssod.org/pages/consumer-resources/types-of-grasses on April 13, 2016
[65] Absolutely Bushed. “When to Re-seed or Re-sod Your Lawn.” January 28, 2011. Accessed at http://absolutelybushedlandscaping.blogspot.com/2011/01/when-to-re-seed-or-re-sod-your-lawn.html on April 13, 2016

(survives, is dormant). The watering season for the Wisconsin climate is mid-April until late September.

- **Mowing -** Optimal mowed height of 1-2.5 inches - will tolerate close mowing in cool climates. Clippings from frequent mowings can be left on the lawn, as Fine fescue does not develop thatch. Mowing grass short during October and November is important for the over-winter success of the grass. Recommended mowing period of every five days in summer conditions.[66]
- **Soil & Fertilizer -** Tolerates acidic soil, growing within a soil acidity range of pH 5.0 to 6.5. Lowest fertilizer requirements of cool-season grass species. “High nitrogen fertilizer” with 0.5 lb. of nitrogen per 1,000 sq. ft. per season (note, not 0.5lb of fertilizer, but 0.5lb. of N compound), in spring and fall. While late fall or early winter are good times to fertilize cool season grasses (biologically and because fertilizer is inexpensive at this time), this practice adds considerably to nutrient run-off and should be avoided.
- **Disease, Weed & Insect Control -** Most varieties have good resistance to many turfgrass diseases. Mixed with other grasses, fine fescue adds disease resistance to the turf. It has occasional susceptibility to summer diseases in hot climates, especially in moist, fertile soil. Leaves and debris must be cleared from the field before over-winter snow sets.
- **Installation, Repair & Re-sodding -** While *seeding* must be done during cooler (“shoulder”) seasons, sodding can be done May-October with proper soil prep. Watering newly laid sod requires deep, extended waterings soon after re-sodding to encourage the plants to extend roots deep into the ground, in order to develop deep root growth. Usage should be minimized during the first 4-6 weeks after sodding. Re-sodding should occur when more than 40% of the field is degraded.

Additionally, while designs cannot be easily changed on artificial fields, painted field sections require routine re-application for grass surfaces.

HEALTH IMPACTS OF ARTIFICIAL TURF

The main human health concerns for artificial turf fields are associated with the use of a rubber crumb infill made from recycled tires. The concerns are related to the exposure to the organic compounds and heavy metals within the rubber crumb through dermal uptake, ingestion, and the inhalation of associated volatile organic compounds (VOCs).[67] There are also concerns about the exposure to the high surface temperatures that the artificial turf can reach on warm sunny days.

Contaminant Exposure Risks of Turf

Through physical contact with some materials in artificial turf, users of artificial turf fields may be exposed to harmful contaminants. The risk of exposure varies by type of synthetic turf.

[66] Personal communication with Tom Reidy. Biederman Redevelopment Ventures. April 15, 2016
[67] Cheng, H., et. al

- **Rubber Crumb from Recycled Tires -** There is currently no consensus on the effects of artificial turf on human health; however, there are many unknowns, which have lead to public concern (see later section). Overall, studies have shown that the tire crumb on artificial turf fields poses low risks to human health. One study, cited by Cheng *et al.,* did demonstrate that the inhalation of polycyclic aromatic hydrocarbons (PAH) emissions from artificial turf fields could result in cancer for professional athletes with 30 years of exposure at 5 hours per day, 5 days per week, year round. However, this study reported that discontinuous users or amateurs were not at risk.[68] Luz Claudio similarly describes in *Environmental Health Perspectives* that most current studies have reported that, given current knowledge, there is no elevated risk from artificial fields, even for children.[69]

    - Despite the low risk to casual users demonstrated by the current literature, Claudio notes that there is currently little or no toxicological information available for many of the VOCs released by the rubber crumb used in artificial fields. There is also a variability in tire construction and a subsequent lack of chemical characterization in the crumb rubber used, which makes it difficult to truly assess potential hazards. In his analysis of multiple studies, David Brown additionally notes that, despite the initial findings of low exposure risk by the current literature, the available research is still too limited to encompass the complexity of exposures, and so a maximal safe exposure level is not currently possible.[70]

- **NikeGrind -** There are still limited studies on the health impacts of NikeGrind infills. A spokesman from Nike, Greg Rossiter, stated that their infill meets their Restricted Substances List (RSL) standards, which is based on stringent global chemical restrictions, and that the material is routinely tested against safety standards in an independent lab.[71]

- **Envirofill -** Envirofill is touted as an alternative to rubber crumb infill that, according to its manufacturer, contains no odor, VOCs, heavy metals, benzene, or carbon black.[72] There have been no studies on any related health risks of using the sand coated in an acrylic coating with Microban antimicrobial technology.

Temperature Risks of Turf

Artificial turf can reach high temperatures due to the chemical and physical properties of the materials used to manufacture artificial turf and fill, presenting risks to human health.

---

[68] Ibid.
[69] Claudio, L. (2008). Synthetic turf health debate takes root. *Environmental Health Perspectives, 116*(3), A116-22. Accessed at on http://proxy.lib.umich.edu/login?url=http://search.proquest.com/docview/222644322?accountid=14667 on April 15, 2016
[70] Brown D. "Exposures to Recycled Tire Rubber Crumbs used on Synthetic Turf Fields, Playgrounds and as Gardening Mulch." 2007. Accessed at http://www.ehhi.org/reports/turf/turf_report07.pdf on April 15, 2016
[71] Alba, M., et. al
[72] US Greentech Inc. "Crumb Rubber Safety." 2016. Accessed at http://www.usgreentech.com/sports/envirofill/crumb-rubber-safety April 15, 2016

- **Rubber Crumb -** When subjected to direct sunlight, artificial turf fields can reach high temperatures, which can pose a health risk, as they can cause skin injuries,[73] heat stroke, and heat exhaustion.[74]
    - For a rubber crumb infill, temperatures can reach as high as 160°F (71°C). Temperatures on artificial turf can reach temperatures of 122°F (50°C) on a summer day where outdoor temperatures are 78°F (25.5°C). Artificial fields have been shown to be 60°F (71°C) hotter than nearby grass fields.

- **NikeGrind -** NikeGrind utilizes AstroTurf's "AstroFlect" technology that deflects infrared rays, and thus reduces heat.[75] The infill is additionally encapsulated in the rootzone that the NikeGrind system uses, leading to less exposure to direct sunlight. Since the infill is not black (it is either green or multicolored) it absorbs less heat. According to AstroTurf's regional sales manager, NikeGrind can reduce temperatures from 15-18% of a traditional recycled tire rubber crumb.[76]

- **Envirofill -** Envirofill is reported by the manufacturer to have temperatures of up to 37°F (2.77°C) lower than similar fields with rubber crumb, however the fields can still reach high temperatures. The manufacturer cites a test performed by the Innovanet Technology Group in 2010 which showed Envirofill fields reaching temperatures of 116.8°F (47°C). The conditions of the test were not reported.[77]

Watering of all types of artificial turf fields is recommended in order to reduce the temperature of the field for use. A study by A.S. McNitt showed that irrigation of a turf field lowered the temperature to that of a nearby grass field of 84.2°F (29°C), but within 5 minutes the temperature had risen to 120°F (49°C). SporTurf, a company that was consulted in preparation of this document, recommends maintenance practices and a watering schedule where the field is watered at intervals throughout the day. McNitt reports that for a field size of around 72,000 square feet, approximately 8,000 to 10,000 liters (approximately 2100 to 2600 gallons) of water should be applied evenly across the field.[78]

Smell of Artificial Turf

Another issue with rubber crumb infill is the unpleasant odor that is emitted when the field heats up under direct sunlight. While this smell is not hazardous, it is often a deterrent from using

---

[73] Claudio, L. (2008).

[74] Synthetic Turf Council. "Guidelines for Minimizing the Risk of Heat-Related Illness." 2013. Accessed at http://c.ymcdn.com/sites/www.syntheticturfcouncil.org/resource/resmgr/files/stc_guidelines_for_min._risk.pdf on April 14, 2016

[75] AstroFlect. Accessed at http://www.astroturf.com/astroflect/ on April 14, 2016

[76] Personal communication with Rich Jordan and Rob Mitchell. AstroTurf. April 15, 2016.

[77] Turf and Infill Thermal Study. (2010). Innovanet Technology Group. Accessed at http://www.usgreentech.com/themes/site_themes/usgt/uploads/products/Envirofill_Heat_Test.pdf on April 11, 2016

[78] McNitt, A. S. (2005). Synthetic turf in the USA-trends and issues. *International Turfgrass Society Research Journal*, *10*, 27-33.

rubber crumb infills.[79] The Envirofill option claims to be odor free,[80] and there is little information as to the smell of NikeGrind fields.

Perceived Human Health Risks of Artificial Turf

Despite initial reports showing low risks to human health, public and government officials are increasingly concerned about the potential risks from the unknown chemical characterization of rubber crumb infill from recycled tires.[81] Due to limited research on the true risks, there has been vocal opposition from groups of parents and other concerned citizens who oppose the local installation of artificial turf fields.

In Massachusetts, a state where over 300 artificial turf fields have been built in the last decade, there is currently pushback from parent groups. One example of this opposition is seen in the town of Medway where parents are pushing for signs to be posted at artificial field sites, warning of the potential hazards. Similar opposition is being seen as the debate over artificial versus turf fields is occurring nationwide. The Los Angeles Unified School District and the New York City Parks Department have already stopped construction of new fields with rubber crumb in response to concern about lead content. In California, legislation is being pushed that would prohibit state funds to be used to build new artificial fields and would require towns to examine alternative options before making a decision.[82] Similarly, individual legislators in Minnesota, New York, and New Jersey have called for a moratoria on new synthetic turf installations until more research into the potential hazards has been conducted.[83] Despite the lack of evidence linking health impacts to the use of a rubber crumb infill, there is a significant negative public perception of these fields that could potentially cause opposition when installing an artificial turf field with a rubber crumb infill.

There have been a few case studies where NikeGrind has been chosen over a traditional rubber crumb made from recycled tires due to public concern about health risks. In 2014, the Kennedy Catholic School in Burien, Washington changed their installation to a NikeGrind system in order to give “peace of mind to the parents and players."[84] Similarly in 2015, St. Mary’s Academy in Englewood, Colorado, chose to switch their product to a NikeGrind system after parents and donors voiced concerns as to the health impacts of a traditional rubber crumb field.[85] NikeGrind has also been recently installed in three Wisconsin artificial turf fields, with two in Appleton and one in Madison.

---

[79] Cheng, H., et. al

[80] Maximum Playability. (2016) US Greentech Inc. Accessed at http://www.usgreentech.com/sports/envirofill on April 13, 2016

[81] Han, I. K., Zhang, L., & Crain, W. (2008). Hazardous chemicals in synthetic turf materials and their bioaccessibility in digestive fluids. *Journal of Exposure Science and Environmental Epidemiology*, *18*(6), 600-607.

[82] Jedra, Christina and Jenifer McKim. (2015, May 9). Toxic Turf? Movement Grows Against Synthetic Turf. *The Huffington Post.* Accessed at http://www.huffingtonpost.com/2015/05/09/toxic-turf_n_7218728.html on April 14, 2016

[83] Han, I., et. al

[84] Alba, M., et. al

[85] Dyer, Kyle. “A field of ground-up Nike shoes.” 9News. April 7, 2015. Accessed at http://legacy.9news.com/story/sports/high-school/2015/04/07/nike-grind-st-marys-academy/25417611/ on April 14, 2016

ENVIRONMENTAL IMPACTS

Lifecycle Analysis

Life cycle analysis is a tool that is used to calculate the total impacts of a product from "cradle-to-grave," which includes raw material production, manufacture, transportation, use, and disposal. There have been limited life cycle analyses conducted on the impacts of artificial turf fields as compared to natural grass fields. The studies that have been conducted have been limited to artificial turf fields using a rubber crumb infill. There is currently limited knowledge of the cradle-to-grave impacts of alternative fill types such as sand, NikeGrind, Envirofill, or coconut or corn husks.

From the comparisons that have been conducted, artificial turf fields have significantly higher greenhouse gas emissions across their entire life cycle. An analysis of multiple reports showed a consensus of emissions from the life cycle of artificial turf to be around 55 tons of CO_2 equivalent.[86,87] While there was not a consensus on the amount of greenhouse gases for natural grass fields, there was a consensus that the natural grass field had significantly lower life cycle emissions than an artificial turf field. Some studies accounted for the carbon sequestration capability of grass, which resulted in much lower emissions than the studies that did not include carbon sequestration.

All studies showed that a natural grass field uses significantly more water than an artificial turf field; however, in the 2015 study performed by a University of Michigan graduate student group, it is noted that in regions that are not constrained by water it is important to consider the emissions impacts of an artificial field when making a decision (see **Figure 4** for Wisconsin precipitation data).[88] Wisconsin has been identified by the Columbia Water Center as an area with a low water stress index of 0-0.3, which indicates that the demand for water is a very small fraction of the water resources that are available to the state. The regional water stress index tool, developed by the Columbia Water Center, accounts for rainfall as part of the renewable water supply. A study by Konstantinos *et al.* that examines trends of increasing or decreasing droughts in different U.S. states shows that Wisconsin has had decreasing droughts from 1950 to the present date. This implies that there is little or no risk of a drought occurrence in this area. As a country, studies show that United States is not at risk for high water stress index by the year 2040.[89] **(Annex 3)**

---

[86] Cheng, H., et. al

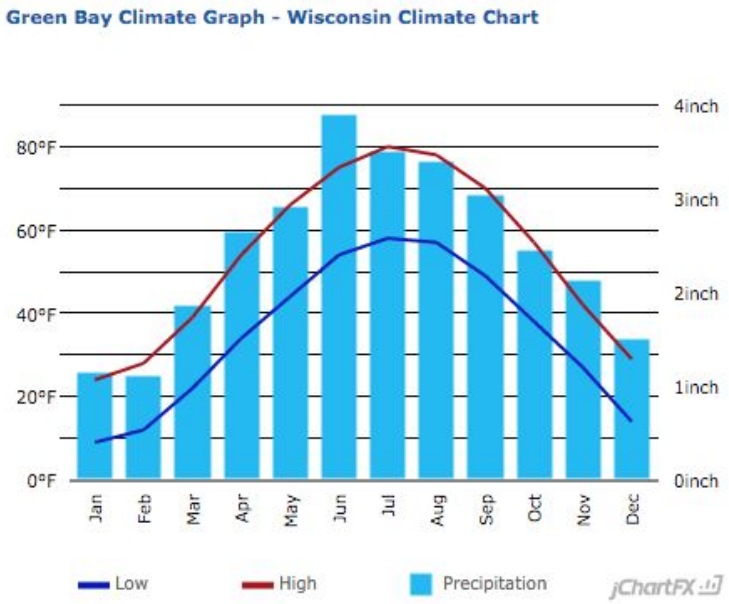
[87] Meil, J., & Bushi, L. (2009). Estimating the Required Global Warming Offsets to Achieve a Carbon Neutral Synthetic Field Turf System Installation. Athena Institute. Accessed at www.athenasmi.org/projects/docs/UCC_ project_ATHENA_technical_paper. Pdf on April 12, 2016.

[88] Conzelmann, J., Fuchs, M., List, B., Muelle, R. (2015). *Environmental Implications of Natural Grass versus Artificial Turf Football Fields.* Unpublished student report at the University of Michigan.

[89] Andreadis, K. M., & Lettenmaier, D. P. (2006). Trends in 20th century drought over the continental United States. *Geophysical Research Letters*, *33*(10).

There is also the possibility to reduce water use through the proper calculation of water needs, use of drought resistant varieties of grass, use of grass with deep root systems, and use of reclaimed water sources.[90]

Figure 4: Precipitation and Temperature in Wisconsin by Month[91]



Little research has been done regarding the life cycle impacts of the NikeGrind or Envirofill artificial turf fields due to the fact that both are relatively new technologies. Envirofill is touted by its manufacturers as environmentally friendly due to the fact that at the end of the field's 8 year life span the fill can be reused on a new field for another 8 years, for a total of 16 years of use for the fill.[92] NikeGrind reuses components of old athletic shoes, which would otherwise be landfilled. While the reusability has the potential to reduce environmental impacts at the disposal stage of its life cycle, a full life cycle analysis is necessary to understand the complete impacts of both types of artificial field systems.

Ecotoxicity

Both natural grass and artificial turf fields have the potential to introduce contaminants into the Titletown environment and the greater Green Bay ecosystem. This potential is called "ecotoxicity" and is described below for each turf option.

- **Artificial Turf with Rubber Crumb -** While studies of ecosystem impacts are still inconclusive, the ecotoxicity of leachate from rubber tires has long been recognized, and

[90] Natural Grass Athletic Fields. (2009). Sports Turf Management Association. Accessed at http://www.stma.org/sites/stma/files/STMA_Bulletins/NaturalGrassFields.pdf on March 30, 2016
[91] US Climate Data. Accessed at http://www.usclimatedata.com/climate/green-bay/wisconsin/united-states/uswi0288 on April 2, 2016
[92] A Proven Infill Solution. (2016). US Greentech Inc. Accessed at http://www.usgreentech.com/our-difference on March 29, 2016

leachate from used tires was found to be more toxic than new ones. Zinc is the major constituent in leachate. The report by Cheng *et al.* explains that the drainage from artificial turf fields, which has an elevated level of zinc, has the potential to be harmful to "the growth, survival, and reproduction of aquatic plants, protozoans, sponges, molluscs, crustaceans, echinoderms, fish, and amphibians" at low concentrations.[93]

- **Artificial Turf with Envirofill -** There are no current studies on the ecotoxicity of envirofill, as the technology is new as of 2004, which leaves the potential for future findings on the environmental impacts of leachates from the synthetic coating.
- **Artificial Turf with NikeGrind/EcoGrind -** The infill from recycled shoe rubber has not been studied as extensively as rubber crumb, and there is no current research on the ecotoxicity of the materials.
- **Natural Grass -** The use of fertilizer in the maintenance of natural grass fields has the potential for nitrogen and phosphorous losses due to runoff, leaching, and volatilization. Nitrogen and phosphorous losses through runoff and leaching can lead to eutrophication in water sources. Proper management of natural turf fields can reduce the potential environmental impacts of using fertilizer. These management techniques include soil testing, using the correct fertilizer and the right amounts of fertilizer to match the needs of the field, using aeration, returning clippings to the field, and applying fertilizer at the right time (especially, avoid fertilizing on frozen ground).[94]

Ecosystem Services

Natural grass fields can provide ecosystems services such as carbon sequestration, biodiversity, and cooling effects. The grass supports biodiversity by providing habitat for worms and insects, which are fed on by birds and other animals. Grasses provide a cooling effect through transpiration and dissipating radiant heat in urban areas. It can also reduce the energy inputs required for the cooling of adjacent homes and buildings.[95]

USAGE AND OTHER CONSIDERATIONS

Aesthetics

When kept in good condition, grass fields are more aesthetically pleasing than artificial turf. However, during the months of November-May, grass fields lose their green color and their pleasant aesthetic. During drought conditions, grass fields can turn brown due to excessive heat and water scarcity.

---

[93] Cheng, H., et. al

[94] Gardner, David. (2015, July 16). Fertilizer Programs. *Sports Field Management.* Accessed at http://www.sportsfieldmanagementmagazine.com/columns/turf-health/fertilizer-programs/ on April 12, 2016

[95] Beard, J. B., & Green, R. L. (1994). The role of turfgrasses in environmental protection and their benefits to humans. *Journal of Environmental Quality*, *23*(3), 452-460.

Tailgating/Food and Beverage

Whether on a natural grass or artificial turf surface, it is our recommendation that tailgating either not be allowed on the Titletown field or be conducted in a restricted manner, due to the significant potential negative impacts on overall field health and durability.

Generally, food and beverages are not allowed on most artificial turf surfaces. Food and beverage damage to artificial turf is not covered in the field's warranty plan, with the owner assuming liability for damages due to this reason.[96] Although liquid spills can be flushed through the system with water application, improper cleaning of dropped food or food particles from the surface could also result in the attraction of insects and pests. Finally, charcoal grills pose a significant threat to turf health as loose or dumped coals could burn and permanently damage the field.

The presence of food is less problematic on natural grass surfaces. However, grass is more sensitive to the high impacts an event like tailgating would have. As tailgating would be occurring in the fall and winter, field managers would have to be highly attuned to weather and field conditions and have to make tough judgment calls regarding the possibility of tailgating on a grass surface. Should the field be wet or slushy with snow and ice, there is a high probability that the field would be damaged to an extreme level if tailgating would be allowed to occur, resulting in high levels of necessary sod replacement.[97] Communication to the public regarding tailgating on the field would potentially become problematic, with a lack of certainty over whether it would be possible given weather and field conditions.

Flame/Heat Sources

While natural grass turf can be repaired relatively easily using seed after exposure to flame, areas of artificial turf exposed to flame would need to be replaced. All artificial turf surfaces are composed of plastic (Polypropylene or Nylon) or a combination of plastic and soy-based materials. Any flame source (fire, fired charcoal, cigarettes) or heated liquid (oil runoff from food) could damage the individual plastic grass blades and possibly the underlayer or infill. This damage, according to numerous calls with turf sales representatives, would not be covered under a warranty. To repair this kind of damage, the Packers' facilities team would need to remove the damaged area and patch it with replacement turf.

Tents and Sunshades

A major concern with any on-field tentage would be securing a tent to the field in the event of a high-wind weather event. The type of tent employed and control that the Packers have over the tent choices of fans will dictate the level of risk to the field. For instance, average pop-up tents, which sit on top of the ground are not a concern. Large tents for events, however, frequently require 4-5' stakes to secure the tent to the ground. These stakes pose a significant threat to puncture the backing of the turf, leaving a visible hole in the surface when removed which cannot be smoothed or brushed out.

[96] Personal communication with Rich Jordan. AstroTurf. April 15, 2016

[97] Personal communication with Tom Reidy. Biederman Redevelopment Ventures. April 13, 2016

The Packers would have to find another means of securing the tent to the ground, such as issuing or requiring approved, weighted tent sleeves as the means of securing any tent in place. For any event requiring protection from sun or rain, it is recommended that the Packers obtain and employ organizational tents which have been verified not to damage an artificial turf surface. This option incurs the added cost of purchasing structures for this surface.

Field Usage Policies

Based on the research contained within this document, the following policies may ensure a longer useful life for grass and artificial turf fields:

- Either no tailgating or restricted tailgating on the field.
- No vehicle traffic on the field outside regular maintenance vehicles, such as gators, tractors, and golf carts with turf tires.
- No smoking or cigarettes be allowed on field premises to protect the field surface.
- No pets be allowed to enter the field premises.
- High impact sport activities such as shotput, hammer throw, discus and javelin should be avoided to prevent field damage.

Specific recommendations for high-impact events:

- The Green Bay Packers and/or Biederman should control the management of tents and other small infrastructure to be placed on the field to best maintain the consistent health of the field for future community use.
- Special attention should be paid to how tents and chairs are placed on the field surface to avoid high PSI levels that can damage the field surface. Protective options such as temporary flooring should be considered for heavy chair use.

Annex 1: Re-sodding Costs inflated at 2.3% and discounted at 6% over 16 years

Natural Grass Re-sodding annually	Natural Grass Re-sodding every 2 years	Natural Grass Re-sodding every 3 years	Natural Grass Re-sodding every 5 years
$2,434,246	$1,175,096	$811,074	$469,263

Annex 2: Cost Model Assumptions

Assumptions for All Field Types

- Field Size: 75,300 ft^2
- Labor Costs: $20/hr
- Commercial Water Prices (retrieved from the Green Bay Water Utility):
- First 10,000 ft^3 : $0.0227/$ft^3$
- Next 140,000 ft^3 : $0.0218/$ft^3$
- 150,000 ft^3 : $0.0165/$ft^3$
- Inflation: 2%
- Discount Rate: 6%
- 15 events per year
- 8 hrs/event labor needed for cleaning (both field types)

Turf Cost Assumptions

- Rubber Crumb: $8.50/$ft^2$
- NikeGrind: $8.75/$ft^2$
- Envirofill: $15/$ft^2$
- Grooming Equipment: $7,000 (quoted from FieldTurf and AstroTurf)
- Cooling Water:
    - 1 cooling with water per day
    - 9,000L (317ft^3)/cooling
    - 120 days per year that the turf needs cooling
- Regular Maintenance: 8 hrs/week labor (cleaning and watering for cooling)
- Event Cleaning:
    - 8 hrs/event labor
    - 9,000L (317ft^3) per event for cleaning
- Professional Maintenance $4,000/visit on a schedule of year 3, 4, 5, 6, 7, 8, 11, 12, 13, 15, 16
- Misc. Repairs: $1,500/year
- Cleaning Supplies: $200/year (disinfectant, gum remover, etc.)
- Disposal and Replacement (Rubber Crumb and Envirofill) at the end of year 8:
    - 60% of the initial installation costs
- Disposal and Replacement (NikeGrind):

- Disposal: $0.50/ft^2
- Reinstallation: $4.75/ft^2
- Total: $5.25/ft^2

Natural Grass Cost Assumptions

- Installation: $4/ft^2
- Irrigation system: $30,000
- Mowing: 50 hours labor/year
- Aeration: 15 hours labor/year
- Field Inputs: 15 hours labor/year
- Seeding: 15 hours labor/year
- Irrigation: 10 hours labor/year for maintenance
- Water: 1 inch per week
- Field Inputs: $900/year
- Misc. Costs: $300/year
- Disposal and Reinstallation (Re-sodding): $3/ft^2

Annex 3. Water Stress Index

Given increasing water scarcity and the associated deterioration of the quantity and quality of water sources in many parts of the world, many tools have been developed to map water scarcity risk or water risk.[98] Typically, these tools are based on estimates of the average water supply and demand in each administrative jurisdiction. Often, water risk is basin-wide, while decisions are made at the city or county level. Therefore, analysis which uses tools that show only basin wide risk are inaccurate predictions of potential water risk. In most places, even if the resource is not over-appropriated on average, persistent shortages induced by climate variation can lead to stress. A clear understanding of shortages, in terms of the magnitude, duration and recurrence frequency will better inform localities.

Unlike past work that considers estimates of groundwater recharge and river flow as measures of supply, Columbia Water Center uses precipitation as the renewable water supply endogenous to the area, and considers natural and human uses of this water.

The below figures show the water stress index in the United States by region and well as for Wisconsin specifically. We see that the state of Wisconsin has a water stress index of 0-0.3 which indicates that there is no pressure on water resources here and that the demand for water is a very small fraction of the water resources that are available to the state.

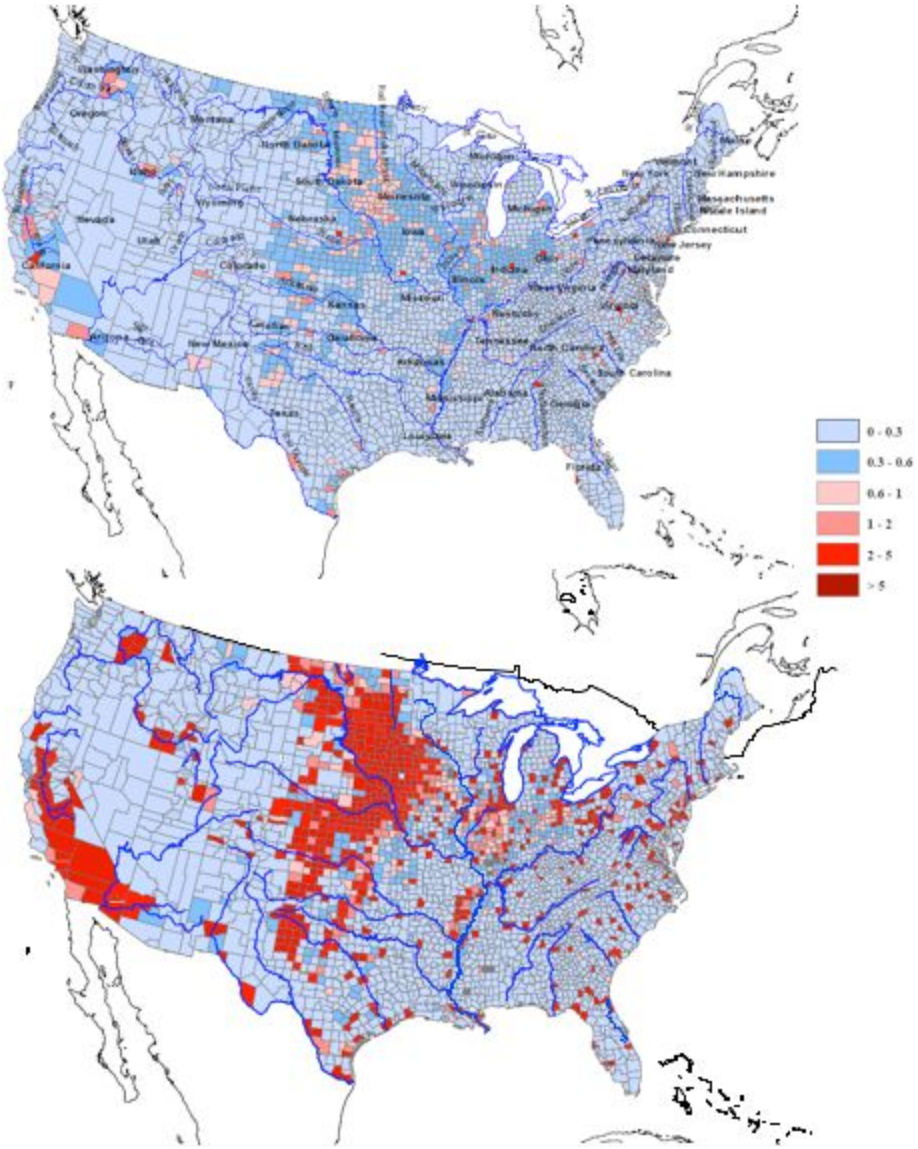
Although originally water stress index had been calculated country wise, it has been found that a region wise water stress index is more relevant and accurate because each country can have

[98] Columbia Water Center. “America’s Water Stress Index.” Accessed at http://water.columbia.edu/research-themes/risk-and-financial-instruments/americas-water-stress-index/ on April 16, 2016

varying water resource demand and supply in various regions within the country. The Growing Blue Tool shows that Wisconsin is in the very low water stress index region (0-0.2).

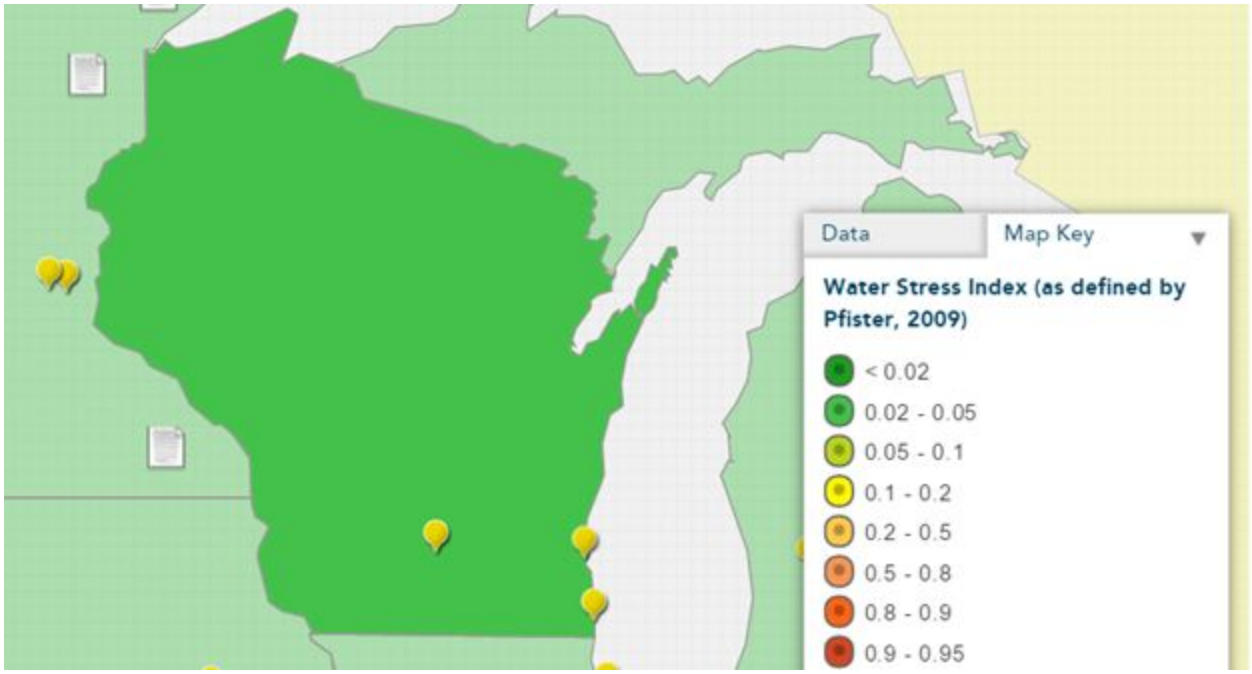
Figure 1: America's Water Stress_NDI[99]

Upper Panel: Magnitude of water stress across the continental USA under within year (NDI)
Lower Panel: Multiyear cumulative analysis (NDC) for 1949-2009 daily supply and demand data.



[99] Ibid.

Figure 2: Growing Blue Tool - Wisconsin state water stress index[100]



[100] Growing Blue. "The Growing Blue Tool." Accessed at http://growingblue.com/the-growing-blue-tool/ on April 16, 2016

Appendix 2: Titletown Sustainable Options for Lighting

Appendix 2.1: Lighting location definitions[101]

Outdoor lighting fixtures means lighting sources which are electrically powered illuminating devices, lighted or reflective surfaces, lamps and similar devices, permanently installed or portable, used for illumination or for advertisement. Such devices shall include but are not limited to searchlights, spotlights, floodlights, streetlights, sign lights, security lights, wall lights, porch lights, area lights, parking area lights, sports lights and sign panels. Outdoor lighting fixtures does not include low voltage (12-24 volt) outdoor lighting or ornamental holiday lighting.

Outdoor merchandising area means car sales lots, equipment sales lots, retail gasoline stations, garden centers, and other similar areas where products are permanently displayed or dispensed outdoors.

Residential site means a single parcel in a residential zone containing a residential structure of one or more dwelling units with parking areas for more than three cars.

Shielded or full cutoff lighting fixtures means outdoor lighting fixtures that utilize flat, clear lenses with no refractorizing elements and which operate in a horizontal position with nonadjustable mounting hardware or brackets. Such fixtures distribute light by means of an internal reflector only. The light source is totally concealed by the fixture housing when the position of observation is at an angle less than 15 degrees above horizontal.

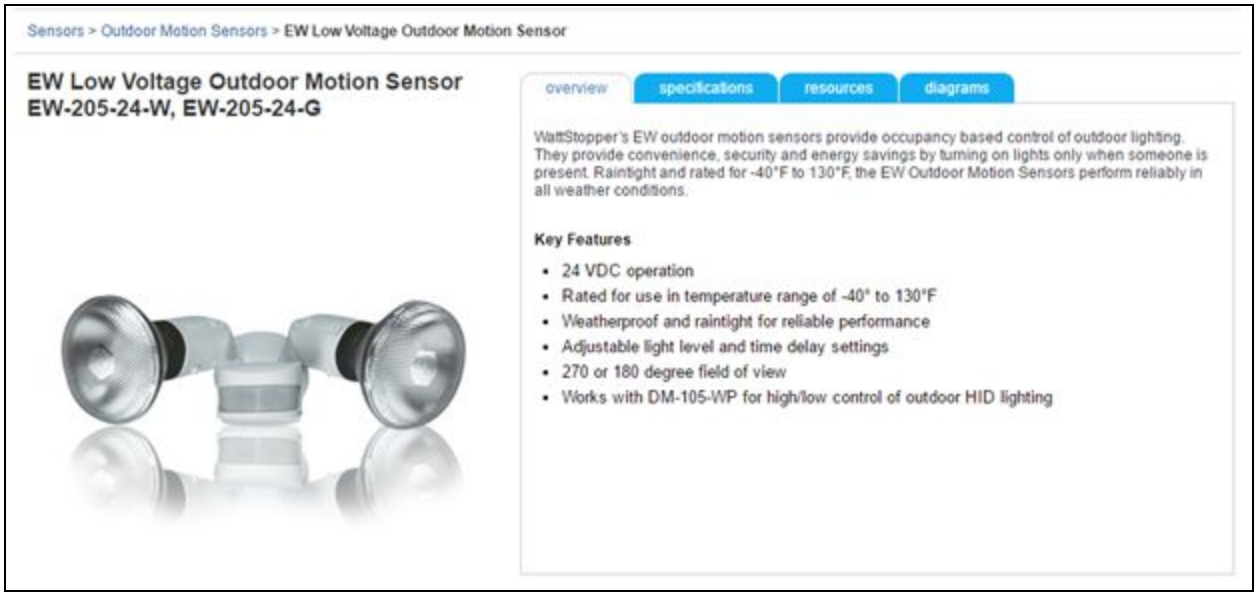
Uniformity ratio means the ratio between the average illumination and the minimum illumination as determined by measurements taken on a four-foot grid throughout the area to be lighted.

[101] Village of Ashwaubenon. Chapter 17 Zoning Code - 2015. Accessed on http://www.ashwaubenon.com/Portals/Ashwaubenon/2015-Chapter%2017%20Zoning%20Code-use_d.pdf on April 14, 2016

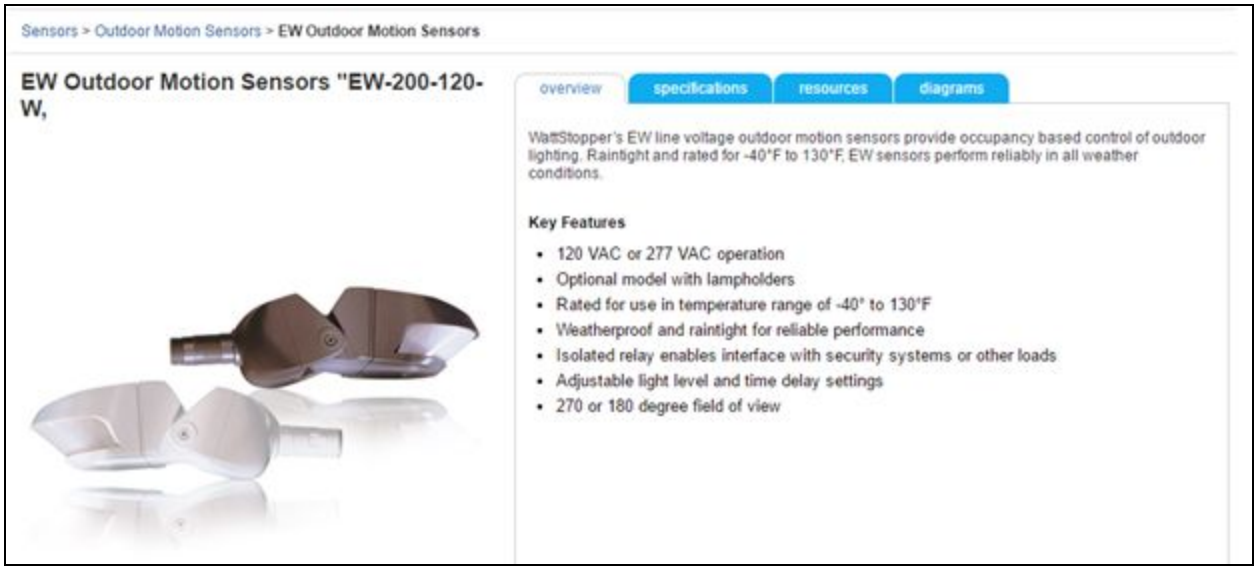
Appendix 2.2: Lighting Product Recommendations

1) Wattstopper

1.1) Low Voltage Outdoor Motion Sensor[102]



1.2) EW Outdoor Motion Sensor[103]

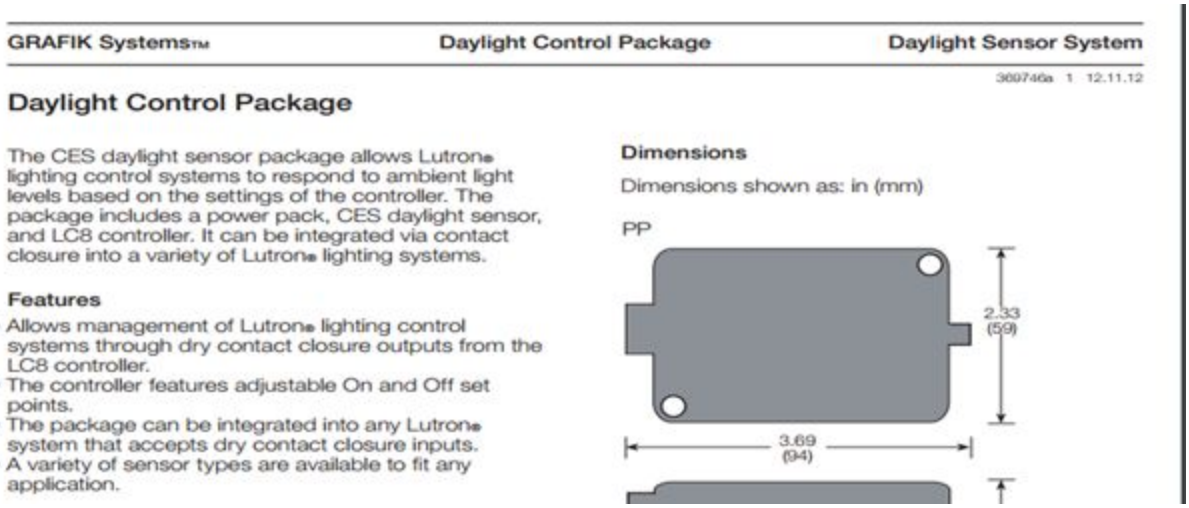


[102] Wattstopper. Accessed at http://www.wattstopper.com/products/sensors/outdoor/ew-low-voltage-outdoor-motion-sensor.aspx#.VxQ_8vkrLIU on April 10, 2016

[103] WattStopper. Accessed at http://www.wattstopper.com/products/sensors/outdoor/ew-outdoor-motion-sensors.aspx#.VxRAfvkrLIU on April 10, 2016.

2) Lutron

2.1) DayLight Control Package[104]



GRAFIK Systems™ | Daylight Control Package | Daylight Sensor System

369746a 1 12.11.12

Daylight Control Package

The CES daylight sensor package allows Lutron® lighting control systems to respond to ambient light levels based on the settings of the controller. The package includes a power pack, CES daylight sensor, and LC8 controller. It can be integrated via contact closure into a variety of Lutron® lighting systems.

Features

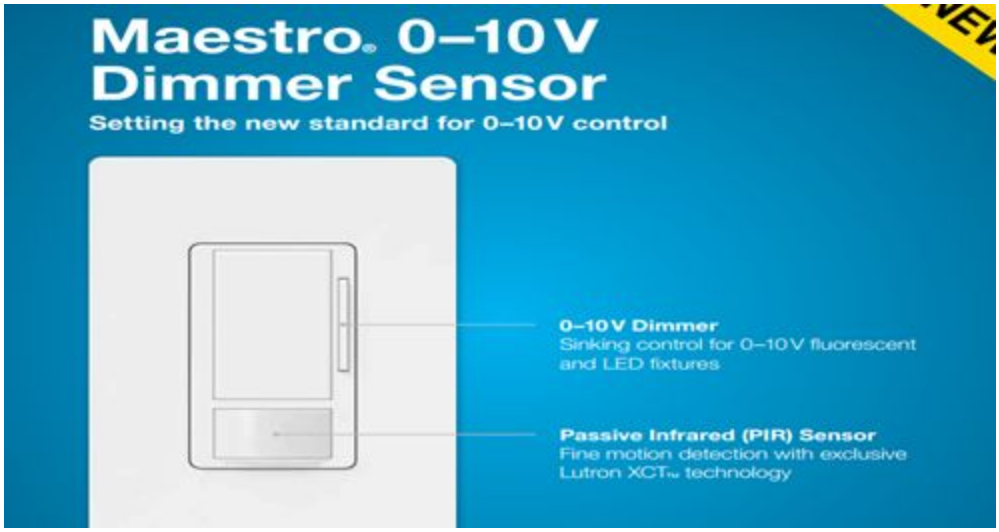
- Allows management of Lutron® lighting control systems through dry contact closure outputs from the LC8 controller.
- The controller features adjustable On and Off set points.
- The package can be integrated into any Lutron® system that accepts dry contact closure inputs.
- A variety of sensor types are available to fit any application.

Dimensions

Dimensions shown as: in (mm)

PP

2.2) Occupancy/vacancy sensors[105]

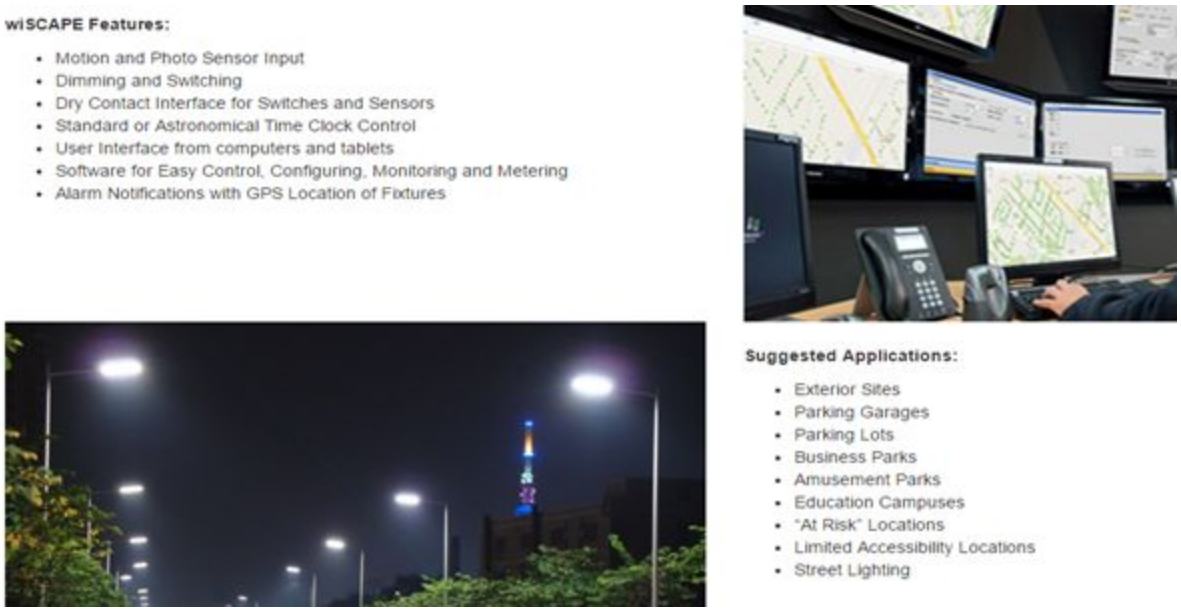


[104] Lutron. Accessed at http://www.lutron.com/TechnicalDocumentLibrary/Daylight%20Control%20Package%20Spec.pdf on April 10, 2016.
[105] Lutron. Accessed at http://www.lutron.com/TechnicalDocumentLibrary/3672530_0-10V_Brochure.pdf on April 10, 2016

2.3) Wireless sensor – daylight[106]

3) Hubbell

3.1) Outdoor Lighting Control System[107]



[106] Lutron. Accessed at http://www.lutron.com/technicaldocumentlibrary/rps_occ-vac_faq.pdf on April 10, 2016
[107] Hubbell Automation. Accessed at http://www.hubbell-automation.com/products/wiscape_wireless_outdoorstreet_lighting_control_system on April 10, 2016.

3.2) Outdoor motion sensors[108]

M Series

Motion Sensors

130°or 270° detection field selections.

Applications

- Security or welcome lighting using a complete kit or by control other electrical devices.

Features

- Center focus range 40/75 feet.
- Broad 20/25 ft. detection range.
- 120 volt 60Hz
- Time On/OFF adjustment, sensitivity control and manual override for initial set up or constant lighting.
- White finish

Certifications

- UL
- Wet listed

3.3) Outdoor motion sensors[109]

H-MOSS® Controls

MAXX™ Harsh Environment Occupancy Sensors

Featuring Passive Infrared Technology

Watertight Wall Mount PIR Sensor

IP66, NEMA 4X, outdoor rated, heavy duty wall or pendant mount sensor with -40°F to 149°F (-40°C to 65°C) operating temperature range and 160° of coverage.

Description	Voltage	Catalog Number
PIR sensor, with isolated relay and photocell	24V DC	**AHP1600WRP**
Adaptor plate for single gang FS boxes	–	**HAP1**
Adaptor hub and nipple for Killark NJ series boxes	–	**HAP2**
Adaptor plate for Killark® NV series boxes	–	**HAP3**
½" NPT threaded hub	–	**HAP4**

Note: For use with CU300HD (120/277V AC, 50/60Hz) control unit.
See page E-22 for technical specifications and coverage patterns.

AHP1600WRP

3.4) Outdoor motion sensors[110]

Heavy Duty Control Unit

Robust latching relay provides reliable performance over many different applications, including plug loads. 20A 100-277V AC, 1HP @ 120V AC, 2HP @ 240/277V AC. Auto or Manual-ON operation. Powers up to six low voltage sensors.

Description	Voltage	Catalog Number
Heavy duty control unit	120-277V AC	**CU300HD**

Note: See page E-19 for technical specifications.

CU300HD

[108] Hubbell Outdoor. Accessed at http://www.hubbelloutdoor.com/products/sm_series on April 10, 2016.
[109] Hubbell Wiring Catalog. Accessed at http://ecatalog.hubbell-wiring.com/productinformation/viewcatalog.aspx?Dest=hubbell-wiring.com/press/catalog/E.pdf on April 10, 2016.
[110] Hubbell Wiring Catalog. Accessed at http://ecatalog.hubbell-wiring.com/productinformation/specsheets/3A/Live/PDF/CU300HD_cart.pdf on April 10, 2016.

Appendix 3: Packers' Organizational Sustainability Goals 1-Pager

Game Plan Items	**Create an Active Network for Sustainability Engagement**	**Efficient Resource Management - Game Day and Every Day**	**Economic Prosperity in Green Bay**	**Community Education and Awareness**
Long-range Goals	• Institutionalize a culture of sustainability through ISO or other process framework • Integrate knowledge of the Executive Committee and other stakeholders to advance sustainability initiatives • Create systems of measuring sustainability outcomes (and financial outcomes thereof)	• Leverage and refine existing waste programs, and involve external stakeholders such as UWGB • Advocate for long-term recycling and composting facilities in the Green Bay area with local stakeholders • Incorporate energy and water efficiency reviews into annual ISO processes	• Develop community of businesses in the Titletown area to spur economic growth • Ensure Green Bay's draw as an attractive area for young professionals • Choose local partnerships whenever economically feasible and programmatically aligned	• Engage staff, fans, and community members as active participants in sustainability • Outwardly demonstrate our commitment to sustainability through education and marketing • Facilitate conversations with community groups and leaders to advance sustainability in the region
Initiatives [Activities to achieve the Game Plan items]	• Survey the Executive Committee, Board of Directors, and players for sustainability and business interests that could benefit from pooling knowledge • Create Sustainability Council based on skilled/ interested board members • Become a member of the Green Sports Alliance • Establish long-term, planned, sustainability internship/iterative project relationship with UWGB	• Implement a compostable waste diversion program • Identify and implement cost-saving or cost-neutral energy and water efficiency projects • Conduct annual audits of day-to-day and game day recycling and composting operations at all facilities	• Leverage sustainability initiatives to create local economic activity • Create partnerships with local businesses to implement GBP sustainability initiatives • Maximize sourcing of locally produced items, with a focus on food • Examine opportunity to fund local innovative ventures in green space through seed grants	• Provide sustainability training and education, customized to specific job roles • Solicit corporate partnerships for sustainable initiatives • Highlight sustainability efforts on Packers' website and at games on video boards • Leverage Titletown infrastructure to educate public on green efforts