TALLGRASS PRAIRIE RESTORATION ON THE KANSAS STATE UNIVERSITY CAMPUS
Site Selection, Implementation Strategies, and Public Outreach

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Tables, Figures, and Equations

Abstract

Tallgrass prairie has just 2% to 3% of its original biome left and even if the original prairie will never be rebuilt, tallgrass prairie restoration offers a chance to undo environmental damage and preserve the ecological features of this forgotten system (Smith et al., 2010). As human populations rise, urban areas are also growing and are leading to a decline in native landscapes. The implementation of restoration projects at various scales in the urban area can help mitigate the effects of urban systems (Bertram & Rehdanz, 2015). This has lead K-State to assembling a sustainability coalition and supporting research group to begin its own efforts. Through a GIS land suitability analysis, soil analysis, survey, and decision matrix, we were able to greatly reduce the number of potential sites and narrow it down to the most suitable option. Suitability was determined through our goals of education, maintenance, aesthetics, safety, and ecological potential. The most suitable site we found was the Regnier Hall lawn. It's current conditions most closely resemble what we researched to be optimal conditions to restore into a tallgrass prairie. At its location, it will provide these services to the widest range of users based on its central location. If the first tallgrass restoration site is a success, we are hoping to implement more of these urban green spaces on campus. With more restoration sites on campus, we are aiming to attract new students and researchers in hopes that they gain knowledge and understanding of environmental risks and an increase in acceptance for prairie conservation. This will result in K-State's campus brand image to transition from an agricultural school to "The Tallgrass University".

Introduction

Tallgrass prairie is the most depleted habitat in continental North America, with just around 2% to 3% of the original landscape remaining (Smith et al., 2010). Though we may never be able to rebuild the original prairie, tallgrass prairie restoration provides an opportunity to effectively reverse environmental damage and restore the important ecological aspects of this lost landscape (Smith et al., 2010). As urban land use continues to expand, native landscapes and ecosystems are negatively impacted or lost all together, such as these prairie ecosystems. To mitigate the effects of loss in native landscapes, urban spaces can be converted into urban greenspace and restoration projects. Urban greenspaces are gardens, parks, greenways, and other areas with grass, trees, and/or shrubs. Prairie restoration and reconstruction projects require a commitment of time, resources, and ongoing management that are vital for the longevity of these smaller ecosystems (Smith et al., 2010). As part of the prairie reconstruction planning process, a list of goals and objectives should be established as well as an approximate budget and timeline, an overview of site characteristics, a reference site, potential seed sources, a seed mix design, site planning, seeding time and methods, establishment management, program monitoring, and long-term management. After goals and objectives have been established, they need to be addressed and incorporated into the prairie reconstruction project (Smith et al., 2010).

The implementation of restoration projects provides a wide array of benefits and services. Environmental services offered by these restoration projects include microclimate regulation, rainwater retention, flood control, promotion of wildlife and biodiversity, improving air and water quality (Bertram & Rehdanz, 2015). Outside of the ecological benefits of tallgrass prairie, there are also societal benefits. Studies have shown that human health and wellbeing are measurably affected by nature and natural environments, even in a small scale or in urban areas (Bertram & Rehdanz, 2015). Mental health and wellbeing, especially among young college-aged individuals is becoming an increasingly studied and relevant topic (Bratman et al., 2019).

More than 70% of the world's population will live in cities within 30 years. Urban green spaces provide settings for a wide range of physical and mental health benefits, and health policy is recognizing nature as a cost- effective tool for planning healthy cities (Shanahan et al., 2015). Urban green spaces support social interactions and social cohesion which in turn improves urban health. Social cohesion is the interpersonal dynamics and sense of connection among people (Jennings & Bamkole, 2019). Initially, environmental education's objective was to foster concern and commitment to solving environmental problems. The focus was on the wellbeing of the natural environment (the ecosystem or biosphere) and not on individuals' wellbeing." (Ronon, T., & Kerret, D., 2020). Urban nature is a promising tool for enhancing people's lives in urban populations. Evidence is beginning to show how some elements of nature enhance people's health and well-being (Danielle et al., 2015). Due to the negative effects associated with urbanization, the drastically reduced levels of natural features present in manmade environments seem to be having effects on human well-being. A benefit people receive from urban green spaces is improved health. This is due to stress relief, cleaner air, and recreational opportunities. In addition to health, people can obtain spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences.

Dose-response modeling is used in health sciences and provides a quantitative approach to informing nature-based health guidelines (Shanahan et al., 2015). The appeal of this is that this could help develop dose recommendations of exposure similar to other health recommendations for public health. The metrics used for measuring the results of nature dosage were intensity of nature exposure, frequency of exposure, duration of exposure, and health responses to nature. As seen in Figure 1, the most common measure that has shown improvements to health has been the duration of exposure to nature. There is an increased health exposure with increased nature dosage. A plateau is expected when increasing the amount of time spent with nature (Shanahan et al., 2015).

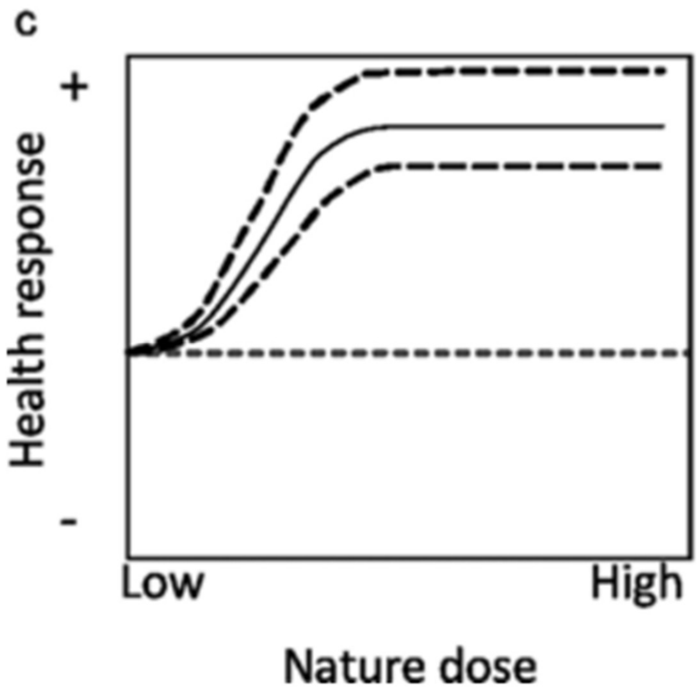

Figure 1: Possible form for the relationship between nature dose and health response from Shanahan et al., (2015). The solid lines show the main trend, and the dashed lines indicate possible variations in scale of the health response.

While urban nature areas are meant for improving the environmental aspects of urban life, it is also about the social aspects of city life and educational resources for people that do not live-in areas with a heavy focus on nature and the ecosystem it inhabits. Urban nature fulfils many social functions and psychological needs of citizens, which makes urban nature a valuable municipal resource, and a key ingredient for city sustainability (Chiesura, 2004).

There has been a growing awareness of human's activities impacting the environment and the limits of earth's biosphere system. This has led to the recognition of environmental education's importance (Ronon, T., & Kerret, D., 2020). A tallgrass restoration site will allow people to engage with lo ng-term restoration and restorative action sites outside the classroom and workshops. Education can lead to an understanding of environmental risks, an increase in public awareness and acceptance for nature conservation, and public participation in decision-making. It will help people to understand the benefits they receive from the ecosystems.

Kansas State University (K-State) is nested in one of the last remaining native, tallgrass prairie landscapes, the Flint Hills. The campus provides an ideal opportunity to restore manicured lawns to a native prairie condition. Our report focuses on establishing goals of a tallgrass prairie restoration on campus, developing a list of site criteria, site selection based on these goals and criteria, and discussion on how to implement restoration and ways to engage the public.

Study Area Description

As mentioned, this site analysis was conducted on the main campus of Kansas State University in Manhattan, KS, right in the heart of the Flint Hills eco-region (Fig. 2). Spanning from northern Oklahoma to just south of Nebraska, the region can be uniquely characterized by the underlying layers of limestone and shale, in addition to much of the remaining Tallgrass Prairie the world has to offer. Roughly 60 miles west of Topeka and 70 miles northeast of Salina, K-State covers an area of 0.933 sq. mi and is comprised of 13.43% tree cover, 26.51% grass, 4.4% bare soil, 55.6% impervious surface (buildings, roads, parking lots, etc.), and 0.06% water. Manhattan sees an estimated 91 days of precipitation each year and some common soil types found in the area include Reading Silt Loam, Clime-Sogn Complex, Smolan Silt Loam, Ivan and Kennebec Silt Loam's, Wymore Silt Clay Loam, Chase Silty Clay Loam, Tully Silty Clay Loam, and Wymore-Kennebec Complex.

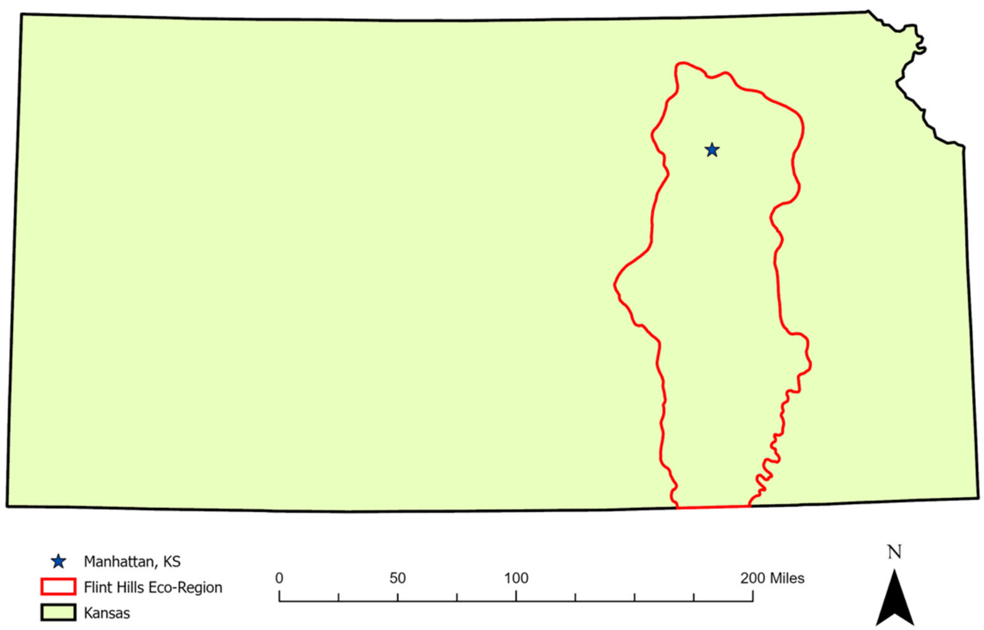

Figure 2: Map of the Flint Hills Ecoregion within Kansas, highlighting the location of Manhattan, KS

K-State was founded on February 16, 1863, as the nation's first land-grant university and while many programs are offered to the students, a large emphasis is placed on agriculture. Originally known as Kansas State Agricultural College, it has since expanded to four campuses striving to offer a wider variety of educational access across the state.

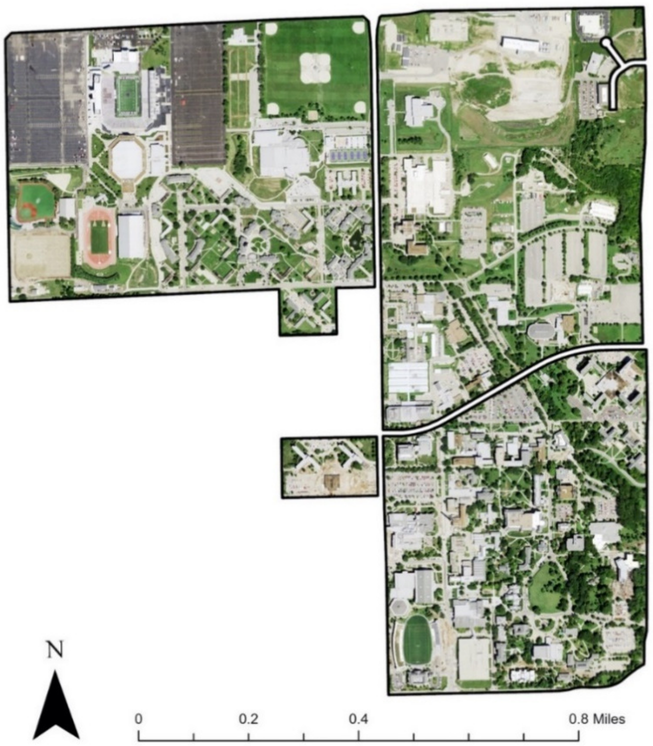

Figure 3: Kansas State University Campus Map

Goals of a Tallgrass Prairie Restoration Site on the K-State Campus

With the theme of sustainability being prominent in today's world, and particularly on college campuses, sustainability is at the forefront of the project. Both environmental education and positive education hold the same goal of increasing the wellbeing of the individual, the society, and the natural environment but that their starting points are opposite. A good starting point to promote sustainable wellbeing would be to implement the approach while targeting children and adolescents through the schools' education system. School students can easily learn and accept new concepts and habits. They will also become the next generation in charge of their own self-care and influence on the wellbeing of the world we live in (Ronon & Kerret, 2020). Sustainable wellbeing is achieved when improving individual wellbeing is correlated with improving the wellbeing of other members of society and the natural environment. This definition, which is termed "sustainable wellbeing", is compatible with both complex systems thinking, and with positive psychology and environmental sustainability (Fig. 4).

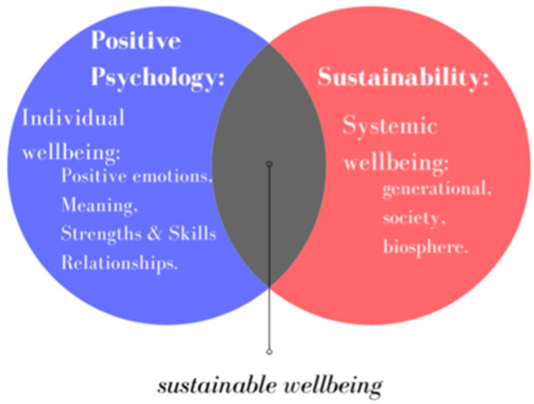

Figure 4: Sustainable wellbeing components (Ronen & Kerret, 2020).

Sustainability initiatives have been put in place on many college campuses including Kansas State, and in many ways, universities are expected to be leaders and advocates on the path to sustainability. While the restoration project does have ties to sustainability, one of the main benefits going forward with the project is the educational assets it will provide, as well as a springboard for other on campus initiatives. K-State can be set apart by its involvement with sustainability initiatives and educating the public on benefits obtained through local ecosystem restorations.

The K-State Sustainability Coalition is a group of K-State stakeholders pushing for tallgrass prairie restoration. Based on a discussion with the coalition, as well as minutes from past group meetings, we identified four goals of a tallgrass prairie restoration site on campus:

- Using the space for education purposes,
- Reducing maintenance and associated costs,
- Improving ecological function and condition, and
- Improving the aesthetic of campus.

In addition to these, it is imperative that safety is always considered and held as a high priority when selecting a tallgrass prairie restoration site.

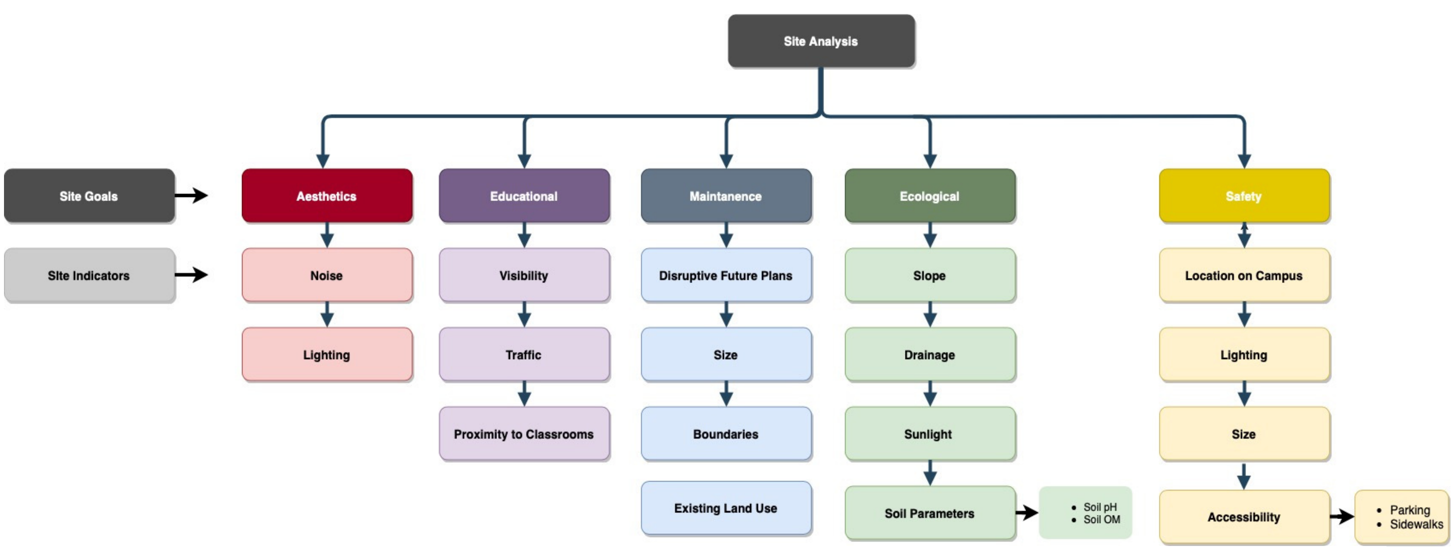

Figure 5: Site Goals and Indicators Used to Select the Ideal Tallgrass Prairie Restoration Site on the K-State Campus.

Site Selection Criteria

Based on the site goals of the prairie restoration project, selection criteria (or site indicators) were chosen and developed to select the ideal location to convert back to tallgrass prairie. These indicators are summarized in Figure 5. The following paragraphs describe in depth the importance of these selected site indicators.

In terms of prairie establishment and its overall ecological function, we focused on important site characteristics such as land use, topography, soil types, hydrology, amount of exposure to sunlight, and plot measurements. The topography (slope), soil types, and hydrology of the site are all key factors in deciding what species to plant and where they should go, as some species thrive in higher, drier environments, while others prefer wetter drainage zones (Smith et al., 2010). More specifically in the ecological site goals, we focused on, topography (Slope) and plant biomass which play a major part in planning for a tallgrass prairie establishment project.

Topography (Slope)

Many prairie plants are perennial, which means that any errors made during a project will last for a long time (Smith et al., 2010). We need to make sure that the seed mixes represent the same soil and topography of where they came from and introduce no species that are not included in the ecosystem (Smith et al., 2010). By doing this you can assure that your plants will grow to the best of their ability.

For our ecological site indicator, we first looked at slope like in Figure 5 in hopes of narrowing down our site selection. We believe that plant biomass can differ based on topography so selecting a site that can positively impact plants is important. A paper published in 2011 talks about how aboveground biomass varies according to landscape gradients (Nippert B. J. et al., 2011). Their findings showed that the plant biomass did vary significantly by topographic position like in Figure 6 (Nippert B. J. et al., 2011). The classifying of topography position was based on four topographic positions; upland, break, slope, lowland and that species height, seasonal leaf area index, and biomass produced increased from the upland and break positions to the slope and lowland like in Figure 7 (Nippert B. J. et al., 2011). They also found that flowering culms by C4 grasses increased as well with topographic gradients like in Figure 8 telling us that they flower more frequently thus benefiting pollinators (Nippert B. J. et al., 2011). This tells us that landscape position is important in getting the best growth factor for your plant and should be a significant factor in determining our site. We were also able to narrow down our sites but picking sites that had little tomography change.

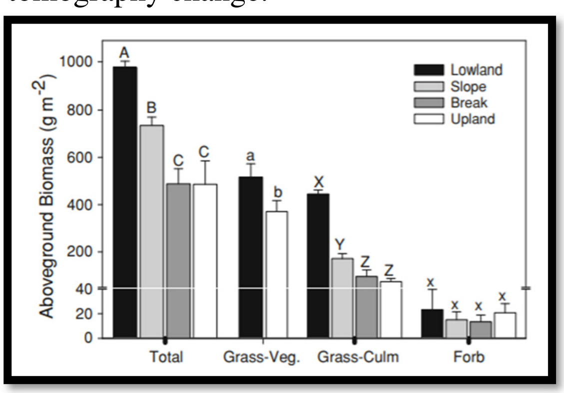

Figure 6: Aboveground biomass across transects positions for 2008 and 2009 for diverse types of vegetation (Nippert B. J. et al., 2011).

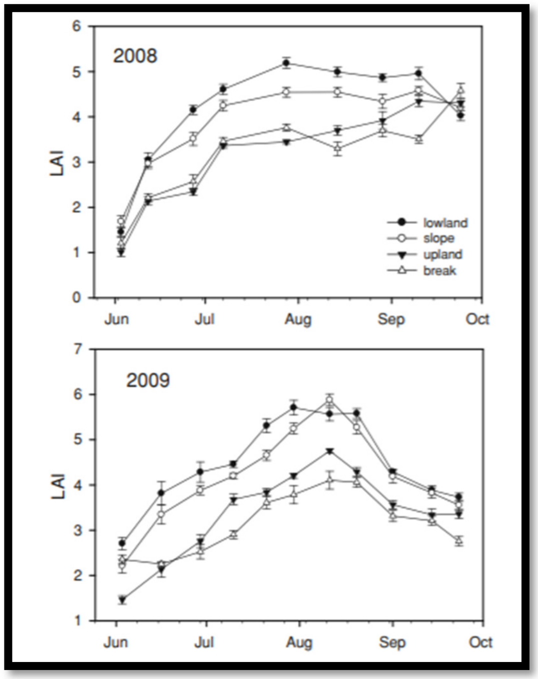

Figure 7: Average leaf area index (LAI) from multiple visitation types from June to October in 2008 and 2009 (Nippert B. J. et al., 2011).

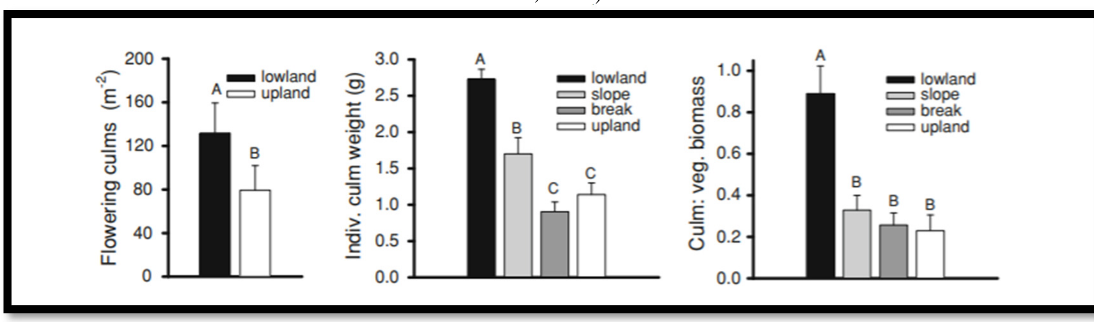

Figure 8: Production of flowering culms by the C4 grass species. The left graph shows the mean number of culms by transect position. The center panel shows the mean weight per culm by transect position. The right panel is the ratio of total biomass allocated to culm versus vegetative biomass by transect position (Nippert B. J. et al., 2011).

Site criteria for these physical site indicators were developed and are shown in Table 1. Knowing that the tallgrass restoration site is intended to replace a manicured lawn that requires a lot of maintenance to upkeep, impervious surfaces and water were immediately removed as no consideration was to be given to these areas. Grass was assigned a value of 5 with a close follow up of trees at 4. Because trees lead to more shaded areas and less direct sunlight, they were ranked slightly below the grassy areas yet still of high suitability. Bare soil was assigned a rank of 2 as these areas would require additional development prior to integrating the tallgrass site. Bare soil additionally removes one of the objectives to replace a high-maintenance lawn with a low-maintenance, native landscape. Incorporating the slope into the land suitability analysis was relatively straight forward in that sites that are flatter are more desirable. Low slopes (0-3%) was assigned a value of 5, with increasing ranges of slope becoming less and less suitable base.

Sites that are well drained were given a rank of 5, with moderately drained at 3, and poorly drained at 1. Lastly, the ideal pH fell at 6 and tapered off quickly when deviating from this value in either direction.

There were five criteria within the Ecological aspect that we analyzed. They are the pH, slope, shade cover, soil organic matter, and if it was a detention basin. Optimal conditions are a pH between five and seven, no slope, no canopy coverage from trees, high soil organic matter, and that there are no drainage issues.

Table 1: Site Selection Criteria for Tallgrass Prairie Restoration on the K-State Campus.

Site Selection Process		**1**	**2**	**3**	**4**	**5**
Step 1: GIS	***Drainage***	Poorly Drained	--	Moderately Drained	--	Well Drained
	Slope	>10	8-10	6-8	3-5	0-3
	pH	>8	--	--	7	6
	Land Use	--	Bare Soil	--	Tree	Grass
Step 2 & 4: Decision Matrix	***Soil pH***	>9/<4		7-9/4-5		5-7
	Soil Organic Matter	--	Chalmers Hall Lawn/Union Parking Garage	Regnier Hall Lawn/Chester E. Peters Rec	Anderson Hall Lawn	S. Coles Lawn
	Land Use	>10 trees	>= 5 trees	>= 3 trees	1 tree	Only turfgrass
	Disruptive plans	Yes	--	--	--	No
	Boundaries	No boundaries	1 sidewalk; 3 building/road/grass	2 sidewalk; 2 buidling/road	3 sidewalk; 1 building/road	Fully surrounded by sidewalk
	Size	Regnier Hall Lawn	Union Parking garage	Chalmers Hall Lawn	Chester E. Peters Rec/ Anderson Lawn	S. Coles Lawn
	Lighting	0 lights	--	3 lights	--	=>6 lights
	Noise	High	--	Medium	--	Low
	Proximity to parking lot	Far	--	Medium	Close	Immediate
	Proximity to bus stop	Far	--	Medium	Close	Immediate
	Central to campus	Edge of campus	--	Off-center; surrounded by campus buildings	--	Central
	Size (Safety)	Chester E. Peters Lawn	Anderson Hall Lawn	Chalmers Hall Lawn	Union Parking Garage	S. Coles Lawn
	Slope	9 and above	7-9	5-7	3-5	0-3
	Shade Cover	No Sun	60-80%	40-60%	20-40%	Full Sun
	Ponding Area		--	Ponding	--	No Ponding
	Visibility	Low	--	Medium	--	High
	Traffic	Low	--	Medium	--	High
	Proximity to buildings	~1 miles of STEM/library/ Union building	<800 m. of STEM/library/ Union building (at least 1)	<400 m. of STEM/library/Union building (at least one)	<100 m of STEM/library/ Union building(at least 1)	<100 m. of STEM/library/ Union building (>=2 buildings)

In terms of maintenance, we looked at the existing sites and the possibility of reducing maintenance work and costs for the area. We looked at the existing land use and boundaries, future plans, and the size. The prime conditions were the land being only turfgrass, the area completely enclosed by sidewalk, no disruptive plans, and a larger size.

In addition to the physical characteristics of the site, the user perspective is important, especially if the designers or stakeholders intend for high use of the space. Approaching site analysis from the user perspective means thinking about the factors that contribute to the comfort and safety of intended users. Key features that contribute to users' comfort and safety and should be included in site selection process are size, location, as well as infrastructure such as lighting.

When considering size, researchers found that small parks evoke less fear in users in comparison to larger spaces (Mak & Jim, 2018). Factors that are determined by size, such as distances to exits also have been found to be important for users. Location is another key factor that is important in the consideration of sites. Users tend to feel safe in areas that are high in user traffic or near areas that are considered safe spaces or neighborhoods (Mak & Jim, 2018). Fortunately, for the sake of this specific analysis, Kansas State University as a whole can fit these criteria, but pedestrian traffic has to be considered. A factor that has a relationship to location is the noise level of a site. A stressor known to impact the comfort levels of individuals within a site is vehicle traffic and noise, so areas that can limit or avoid this are preferred (Gidlof-Gunnarsson & Ohrstrom, 2007). Finally, features such as lighting are more obvious, people feel safer in areas that are well lit at night in comparison to dark spaces (Mak & Jim., 2018).

The overarching goal of safety encompasses user safety and accessibility. We looked at the existing lighting, the site's proximity to a parking lot and bus stop, how central it is to campus, and the size of the site. Optimal conditions for safety were adequate lighting, a parking lot and/or bus stop in the immediate vicinity of the site, the site being in the middle of campus, and being a smaller size. Safety was a high priority for us and had a weight of five. From the remaining sites, Anderson lawn had the closest optimal criteria.

Green spaces offer the opportunity for people to interact with nature and get outdoors. Certain factors can relate urban green spaces to social interactions: open park design, availability of sidewalks, improved access to parks through quality transportation options, shaded areas to support relaxing, functional playgrounds, and organized activities. The level of engagement is based on the qualities of the green space, the intended use, and the area's overall social context (Jennings & Bamkole, 2019). Research shows that if people feel safe to walk results in a positive perception of social cohesion and promotes the interest in using urban green spaces (Jennings & Bamkole, 2019).

In addition to safety and accessibility, using the restoration site for educational purposes was another primary goal. Education was analyzed by evaluating the visibility of the site, how much traffic and exposure the site receives and the proximity to STEM buildings, the library and/or the Student Union. Proximity of educational buildings were important allow for in class walks and demonstrations, while visibility and user traffic were evaluated for passive learning exposure.

Finally, in terms of aesthetics, we analyzed the noise levels and the lighting of the site where the preferred conditions were a low noise level and adequate lighting. This category was found the lowest priority, so it got a weight of two. Both the Chester E. Peters Recreation Complex and the Veterinary Medicine areas had the highest score.

Site Selection Methods & Preliminary Results

The goals and site selection criteria established and summarized in the proceeding section were incorporated into our four-step approach to select an ideal tallgrass prairie restoration site on the Kansas State University campus. The steps are:

1. Conduct a GIS land suitability analysis.
2. Understand and assess the soils of potential sites.
3. Conduct a stakeholder survey to enhance the final decision matrix site selection tool.

4. Develop and use a decision matrix to select a site based on the established goals of the site.

More information about each of these steps are provided in the following sections.

Step 1: GIS Land Suitability Analysis

GIS is an integrated computer hardware and software system designed specifically to manage, manipulate, and interpret spatially referenced databases. GIS analyses are increasingly commonplace, with many applications occurring in the fields of natural resource management (Russell et al., 1997). When looking at an area as large as K-State's campus, it is certainly easy to get overwhelmed by the many possibilities of where to implement a tallgrass prairie restoration site, let alone anything. A land suitability analysis based on GIS is an efficient and effective application within land-use planning and habitat analysis that provides an excellent starting point when narrowing down potential site candidates (Uy & Nakagoshi, 2008). What initially seems like an infinite number of possible sites can be reduced down to a much more manageable number. In order to do this, it is first necessary to identify what the site needs to be successful both physically and ecologically, acquire data to help derive this information via various geoprocessing tools, and overlay them based on the desired importance each is to have on the output land suitability map.

GIS Selection Criteria

The criteria selected for the initial GIS land suitability analysis was dictated mainly by the data readily available. Because of the study area being relatively small scale, a lot of the data investigated, such as hydrography, did not supply enough information to impact the suitability analysis in any significant way and was therefore omitted. Given the data successfully obtained, four main GIS layers were derived and included in the analysis: land use/land cover, slope, drainage, and pH. Each layer was reclassified into a 1-5 scale with higher numbers representing more desirable characteristics. Table 1 provides a summary of these site criteria.

Data Acquisition

The data necessary to perform the initial land suitability analysis consisted of three main data layers. First, land use/land cover data was obtained from the Kansas Forest Service due to its sub 1-meter resolution. This high-resolution land use/land cover data was very important in the analysis as research conducted where only coarse scale data are available would face an increased difficulty in accurately characterizing aggregate classes, which can be expected to produce greater error (Grafius et al., 2016).

The next key piece of data used in our initial land suitability analysis was LiDAR elevation data (1m resolution) downloaded from the Geo-Spatial Data Gateway on the United States Department of Agriculture's (USDA) Natural Resources and Conservation Service (NRCS) website. LiDAR data is a very modern piece of technology that is based on remote sensing and measures various properties of the light between the sensor and the target in order to determine how far away something is.

The third and final piece of data that was critical to the success of the initial land suitability analysis was soil data, downloaded from the Riley County GIS portal which is free to access with permission and obtained login information. The soil data downloaded from Riley County GIS was very similar to what was available on the USDA site, however, it already included many more attributes and descriptive information on the soil itself.

Pre-Processing

Each of our three data layers required some minor pre-processing before they were ready to be implemented into the initial suitability analysis. Often, free data that is downloaded from the internet will need some sort of manipulation for it to be used effectively and that is exactly the case here.

The land use/land cover data (Fig. 9) obtained from the Kansas Forest Service was already in raster format, meaning it consisted of data on a pixel-to-pixel basis rather than vector data which includes points, lines, and polygons. The “Weighted Overlay” tool used to perform the analysis in GIS requires the inputs to be in raster format and therefore the only preparation for this data was clipping it down to our study area. The data initially included the entire city of Manhattan, KS and all the additional land around campus was not of concern.

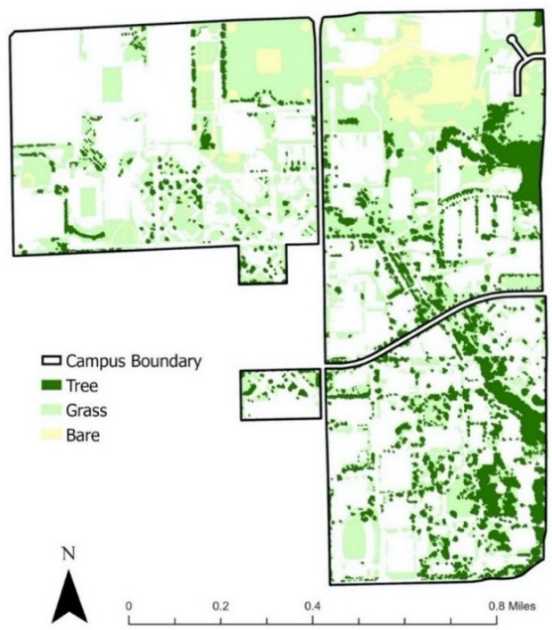

Figure 9: Land Classification Map of the K-State Campus

In order to get a useful layer of slope, a couple things went into the pre-processing for LiDAR elevation data. First, the data was clipped down to our study area to prevent unnecessary geoprocessing that would negatively affect the efficiency of tools in GIS. The clipped layer was then inputted into the “Slope” tool located in the toolset “Surface” within the Spatial Analyst toolbox. This provided an output raster layer with percent slope values that could be derived for each individual pixel. Figure 10 showcases the transformation from LiDAR elevation to slope and concludes the pre-processing necessary for these criteria.

Soil data obtained from Riley County GIS provided the final two data layers necessary for our land suitability analysis: drainage and pH. After clipping down to the area of interest, the drainage attribute (“drainagecl”) was chosen to represent the classification in the mapping frame, that is, unique colors to represent the features of the vector data based on the drainage attribute associated with them (Fig. 11). This classified layer was then inputted into the “Polygon to Raster” tool, found underneath the “To Raster” toolset within the Conversion Tools toolbox. This provided a raster layer of drainage data that was ready for input into the weighted overlay. This same process was completed to get the raster layer for pH, with the only difference being the attribute (“pH”) that the colors were associated with (Fig. 11).

Initial Suitability Map

Figure 12 depicts the results of the initial land suitability analysis. From this point, we selected ten candidates based on both the results of the analysis in addition to discussions held with stakeholders prior to the start of the research. The map on the right side of Figure 12 displays these 6 sites outlined in red and includes areas such as south of the Chester E. Peters Recreation Complex, south of the Veterinary Medicine's Coles Hall, south of the Union parking garage, the eastern portion of Anderson Hall lawn, and a handful of additional locations that will be covered more in detail later in the report.

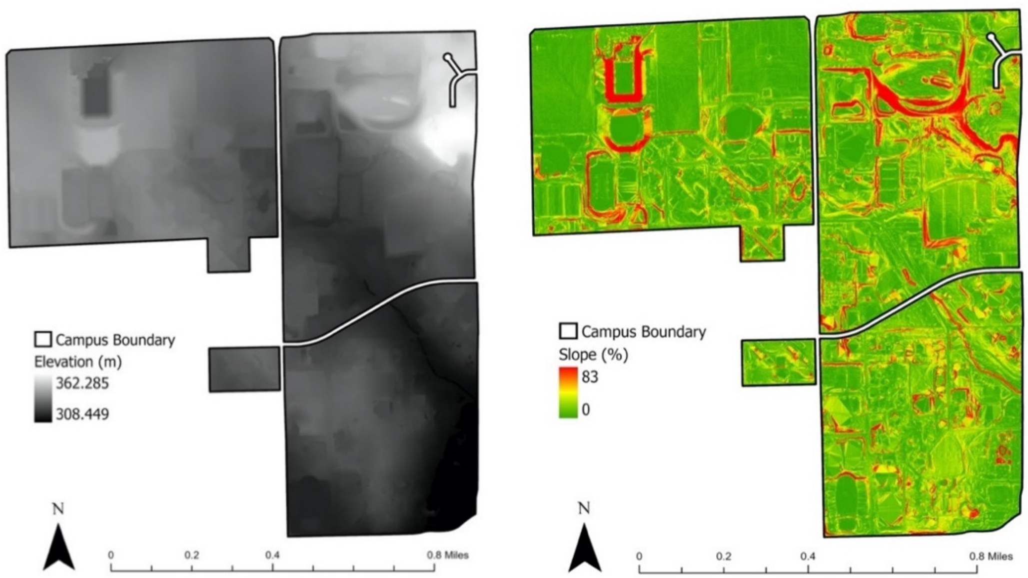

Figure 10 Site Elevation (left) and Slope (right) Maps of the K-State Campus

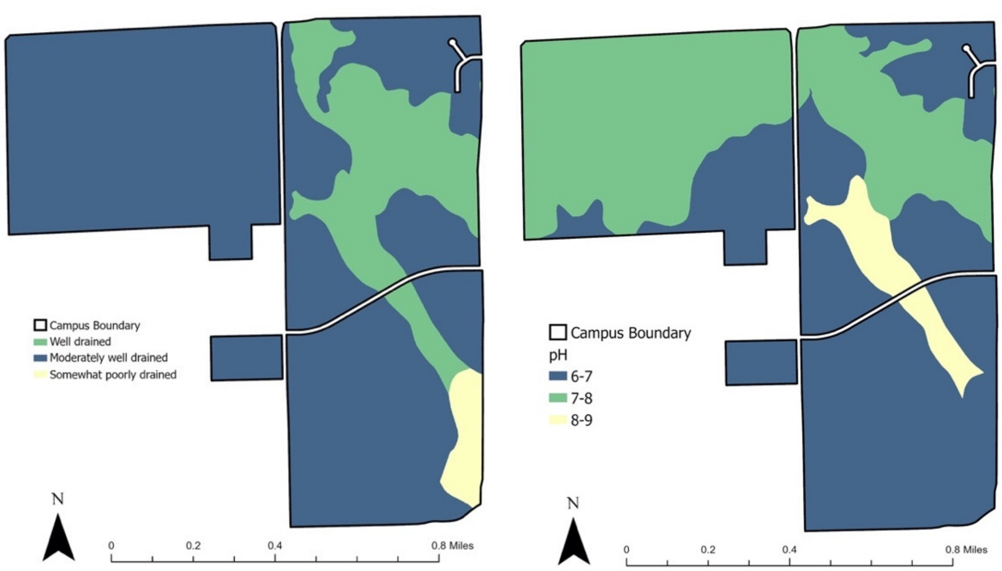

Figure 11: Site pH (right) and Drainage (left) Maps of the K-State Campus

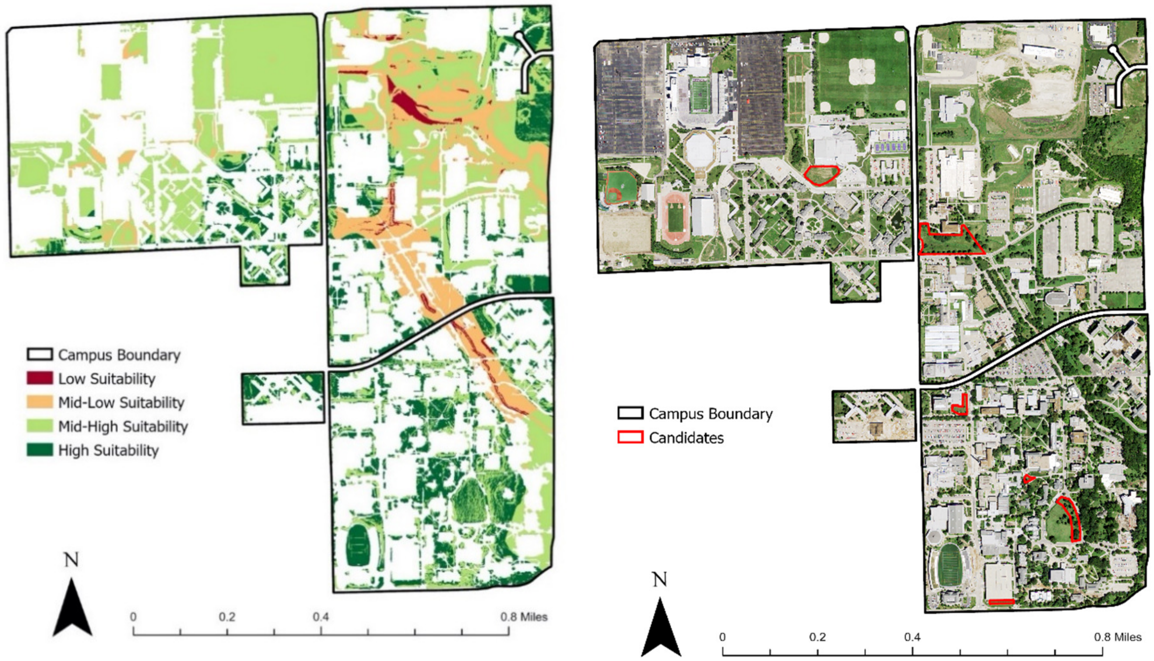

Figure 12: Kansas State University Site Suitability Map (left) and Candidates Map (right) from the GIS Land Suitability Analysis

Step 2: Soil Sampling and Analysis

Following the GIS land suitability analysis, soils were sampled at the candidate sites and analyzed. The soils were assessed for their water content, organic matter, and pH. Soil water content, organic matter, and pH are all assessments of soil quality. Soil pH is important because of its ability to influence soil nutrient availability, and thus a plants ability to thrive in the given soil (Jauron, 2002). Prairie systems, like any other plants, have a desired soil pH level. Soil organic matter is also a key indicator of soil health. It can be indicative of soil available nutrients, influence soil water infiltration rates, and be a key driver in soil biological processes (Franzluebbers, 2002, Kaye et al., 2005). To begin, at least three soils samples were collected from each site location. The collected soils were placed in bags and then stored at 4°C until processing. Soil processing began with the sieving of soil (4mm), and the removal of any plant material such as roots. After the soil was sieved, further analysis could be conducted.

pH

To measure soil pH, the soil must first be created into a slurry. To make the mixture, 5g of the soil samples were mixed in a 1:5 ratio with distilled water (20 ml). To ensure thorough mixing, the slurry was spun for 30 minutes before being measured by a pH meter. Soil pH is summarized in Table 2.

Table 2: pH results for Candidate Sites Selection.

Site	pH Average
Anderson Hall Lawn	6.74
Union Parking Garage	8.23
Chalmers Hall Lawn	8.16

S. Coles Hall	8.34
Chester E. Peters Recreation	8.25
Regnier Hall Lawn	8.09

Gravimetric Water Content and Soil Organic Matter

Gravimetric water content (GWC) and soil organic matter are measured together because they require the soil to be dried. GWC, the first step, is the mass (g) of water per mass (g) of dry soil (Eq. 1) (Topp, 2008).

Equation 1:

$$GWC = \frac{Mass\ Water}{Mass\ Soil} = \frac{Mass\ of\ Wet\ Soil - Mass\ Dry\ Soil}{Mass\ of\ Dry\ Soil}$$

In order to obtain the mass of the wet soil, soil is weighed following sampling before being dried, and the mass is recorded. The optimal mass of wet soil is about 5g. Dry soil is weighed after the wet soil has been dried for at least 48 hours at 105°C and GWC is calculated.

Next, soil organic matter (SOM) was analyzed. The remaining dry soil from the GWC method was ignited. The remaining soil is the final soil mass (g) without the SOM (Eq.2). The weight of the SOM can also be described as the weight (g) lost on ignition.

Equation 2:

$$SOM = Dry\ soil - Ignited\ Soil$$

Equation 3:

$$\%SOM = \frac{Dry\ Soil - Ignited\ Soil}{Dry\ Soil}$$

SOM can be used as an indicator for soil health and fertility. To further analyze the soil, SOM can be broken down into specific organic nutrients in the soil based on ratio estimations. Carbon is estimated to comprise 58% of SOM, Nitrogen 5.8%, and Phosphorus 0.58% (USDA, 2014). The following site values are listed in Table 3. These values will be used in the decision matrix (described later) to help assist in selecting an ideal site for tallgrass prairie restoration.

Table 3: GWC and SOM results for site selection.

Site Averages	**% GWC**	**% SOM**	**% C**	**% N**	**% P**
Anderson Lawn	0.25531	0.04006	0.09060	0.00232	0.00023
Parking Garage	0.20659	0.02209	0.05510	0.00128	0.00013
Chalmers Lawn	0.21691	0.02652	0.06699	0.00154	0.00015
S. Coles Hall	0.35957	0.04862	0.11349	0.00282	0.00028
Chester E. Peters Recreation	0.27349	0.03181	0.07787	0.00184	0.00018
Regnier Hall	0.24603	0.03621	0.07946	0.00210	0.00021

Step 3: Survey

In order to assist with the selection of an ideal site using a decision matrix (to be discussed in the next section), we conducted a survey among the K-State Sustainability Coalition members encompassing the four goals for the site, as highlighted in Figure 5. We asked members of the coalition to rank these goals from most important to least important to them. We received 10 responses from various K-State departments such as Biology, Biological and Agricultural Engineering, Landscape Architecture, Geography and Geospatial Science, and Veterinary Medicine. Results from the survey indicated the goal of improving ecological function and condition to be most important (Fig. 13). The remaining goals were ranked in the following order:

1. Improving ecological function and condition.
2. Using the space for education purposes.
3. Improving the aesthetic of campus.
4. Reducing maintenance and associated costs.

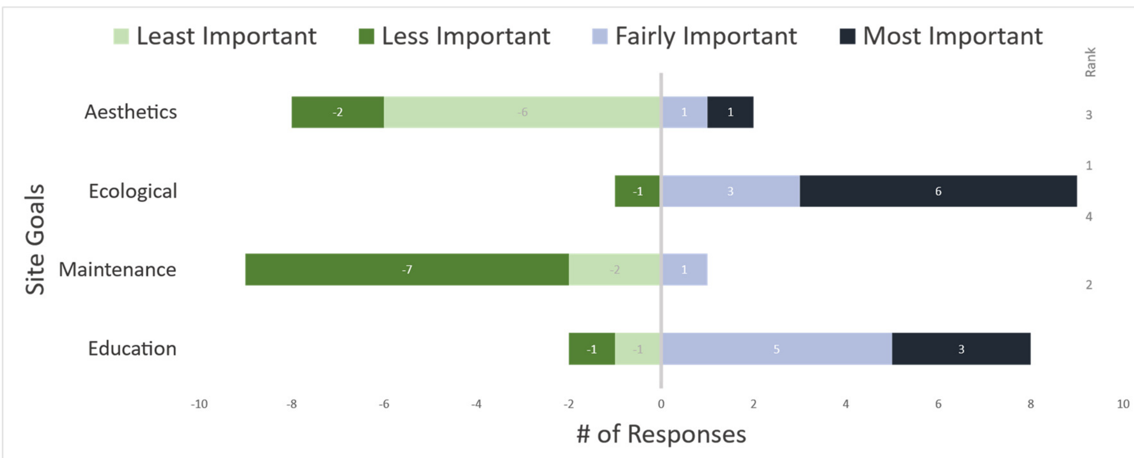

Figure 13: K-State Sustainability Coalition Tallgrass Prairie Restoration Goal Survey Results. The ecological component of the restoration project was the most valued goal among those surveyed with maintenance being the least value.

Step 4: Decision Matrix

The sites were narrowed down to the final six sites after the preliminary GIS modeling and from there, all the data was compiled and analyzed in a decision matrix. A decision matrix is a grid that puts values in the rows and columns and assign numeric values to each based on predetermined criteria. This allows for an objective ranking and evaluation of the data to determine which option is the best. Table 4 provides the final results after calculating the criteria and weights using Equation 4. Table 1 summarizes the site selection criteria used to obtain scores for each site indicator.

Equation 4:

$$Total\ Site\ Score = \sum_i (Site\ Indicator\ Score * W_i)$$
$$*W_i = weight$$

We assigned numerical values to each criteria under the five sections: ecological suitability, safety factor, educational suitability, management, and aesthetics. After scores were obtained for each indicator, they were then weighted based on the results of the K-State Sustainability Coalition survey. We placed higher emphasis on the ecological suitability and safety of the site at weight of 5. The second highest priority was the educational suitability at 4, followed by management at 3 and the aesthetics aspect at 2. We note that the criteria were based off existing conditions, but there is the potential to change the structure or design of the other sites to create optimal conditions for a prairie restoration. Table 4 provide a summary of the results.

Table 4: Decision Matrix Results to Finalize Tallgrass Prairie Site Selection on the K-State Campus. Regnier Hall Lawn received the highest score for educational uses as well as maintenance. The S. Coles Hall received the highest score for maximizing ecological benefits and improving aesthetics. Finally, Anderson Hall lawn received the highest score in terms of safety.

Site Location	Total
Chalmers Hall Lawn	265.5
Parking Garage	256.0
Chester E. Peters Recreation	236.0
S. Coles Lawn	219.0
Regnier Hall Lawn	274.0
Anderson Hall Lawn	261.0

Recommended Tallgrass Prairie Restoration Site

Based on the results of the decision matrix presented in the previous section, the best option overall was found to be Regnier Hall Lawn (See Appendix). This area had the highest scores in educational purposes and maintenance and scored near the top in the other three categories. The best attributes of the Regnier Hall lawn are its:

- High exposure due to its centralized location on campus, increasing use and safety
- High educational potential due to its location, existing site conditions, and that it is completely enclosed by a sidewalk.

The existing conditions of Regnier Hall made it the best option for a tallgrass prairie restoration. It is ideal due to the sidewalks around the site acting as a boundary. Social relationships can influence health through social engagement, social support, social influence, access to information, and increased contact with others. Social interactions in urban green spaces can provide the opportunity to bond with others, create a sense of community, and recuperate from daily life. Regnier Hall is at the heart of campus, right next to Hale Library. Many current and potential students pass this area often on their way to Hale Library, the Union, and Seaton Hall. It is a short walk from any of these building for students to take a break from studying and relax with peers next to the tallgrass site.

The site that had the second highest desirable characteristics for a prairie restoration site was the lawn near Chalmers Hall. While this site was not the highest in any of the categories, it scored near the top in almost all the categories. The Chalmers Hall lawn's best attributes were the proximity to STEM buildings, adequate lighting, close parking lot and it is also completely enclosed by sidewalks, as well. However, what made this area slightly less appealing was its lower exposure and foot traffic, as well as increased shade from trees that would likely need to be removed.

One of our initial goals with the restoration site was for it to not only be an attraction to community members, but to be an educational asset in the sense that it could be used for certain classes. One of the deciding factors on site selection was proximity to classroom buildings so that it would be practical to use the restoration site for relevant classes. The site we have deemed

“The Pizza Slice” next to Hale Library and Regnier Hall has become our most attractive candidate due to it being in a well-lit, highly trafficked part of campus. Being near biological and agricultural buildings, it could certainly be a good site for both educational use and exposure to the public.

The two weakest sites were the area in front of the Chester E. Peters Recreation Complex and the S. Coles Lawn area which came last overall by a noticeable margin. Weaknesses observed with the Chester E. Peters Recreation Comple area were the far distance from campus which affected the accessibility of the site for educational purposes and the safety risks due to the far distance from campus as well as the poor lighting of the area. The least desirable location based on current conditions is the S. Coles Lawn area due to its far distance from campus which creates a safety risk as there is not much traffic in that area and poor lighting in the area at night. The far distance also affects the ease of accessibility for educational purposes. Another weakness to this site was the future disruptive plans that are scheduled for the next few years to fix pipe deficiencies and overflow problems (BG Consultants, 2013).

Tallgrass Prairie Restoration Implementation Strategies

While there are a surplus number of implementation and management strategies for tallgrass prairie restorations that stem from converting farmland, not a lot of research has been done on urban restoration. Some of the strategies can be implemented in an urban environment, but there are some that are unsuitable for a college campus to put into practice. With the correct methods and practices, creating a restored urban prairie can bring back some of the natural landscape and atmosphere.

Implementation

The best strategies for implementation of a restored prairie is either tilling the area or mowing then spraying with herbicides. Most urban sites are converting turfgrass to prairies, so the site must be prepared by getting rid of current vegetation. Tilling is the most common method in rural areas, but since our site is on a smaller scale, it may be unnecessary. Tilling has also shown to lower seedling density (Chin & Harmon-Threatt, 2016), but it is the most efficient way to clear a site. The other method is to mow the area and then typically the area is sprayed with herbicides ensure the plants are killed off (Chin & Harmon-Threatt, 2016). The most used herbicide is glyphosate which does not have any long-term effects on the area and is typically only used for site establishment (Chin & Harmon-Threatt, 2016). Either option would be appropriate for the selected sites.

In most sites, seeds are taken from prairie establishments nearby to maintain similar plant diversity and composition. In a study conducted by Rowe (2010), broadcast seeding was the most frequently used, had the highest survivorship rate, is less expensive, and creates as more natural look to the prairie as opposed to drilling or plugging. Seeding was primarily done in dormant seasons since they “take advantage of spring moisture and allow the freeze-thaw cycle to bury the seeds and provide necessary seed soil contact (Rowe, 2010, p.260). Seeding is important to urban sites as they are also at higher risk of invasive species due to the smaller size and can also give some plants a competitive advantage depending on the mixture. We also believe that nutrients will need to be added at the beginning of the project to help with growth establishment.

Soil resources and nutrients play a vital role with the establishment of tall grass prairies. In a three-year study was conducted at the Konza Prairie Biological Station near Manhattan, KS, to see how plants were affected by different nutrient treatments (Baer et al., 2003). Looking specifically at nitrogen they found that the availability of nitrogen in a newly restored grassland seems to strongly influence above-ground plant species compositions like in Figure 14 (Baer et al., 2003). The nutrient treatments did affect plant productivity and initial soil nutrients can change diversity in newly established prairie through the influence of nitrogen and carbon and that diversity was maximized in soils that closely resembled native prairie soils concerning carbon and nitrogen levels (Baer et al., 2003). Overall, their results showed the effects of nutrient availability on productivity and diversity are like young and mature grasslands; and, that manipulation of these things can influence the composition and diversity of a restored grassland establishment (Baer et al., 2003).

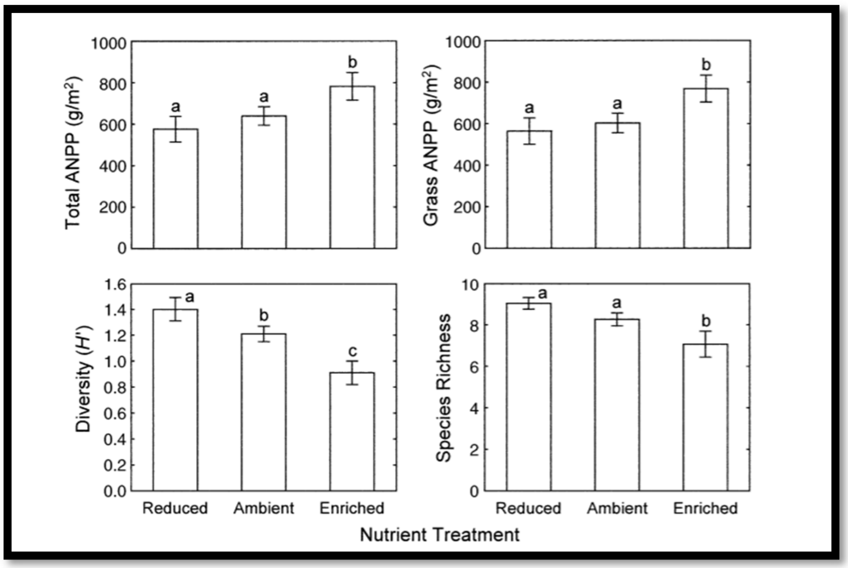

Figure 14:Mean total aboveground net primary productivity (ANPP), ANPP of the dominant C4 grasses, plant diversity, and plant species richness in response to the nutrient treatments throughout the three years (Baer et al., 2003).

To aid the establishment of slow-growing plant species some people add soil amendments to prairie restorations before planting (House, G. L., & Bever, J. D., 2020). In a paper published in 2020, researchers look at how amendments affect the growth and establishment of prairie plant seedlings, and if different functional groups respond differently (House, G. L., & Bever, J. D., 2020). They also look at how amendments affect plant community diversity and if these amendments affect the AM fungal community composition. Findings showed that plant growth was substantially improved by AM fungal inoculation across several growing seasons, and plant community diversity's response to biochar and AM fungal inoculation is minimal (House, G. L., & Bever, J. D., 2020). Overall, inoculation with native AM fungi may aid prairie plant establishment but using biochar soil amendments at the same time had only a slight effect (House, G. L., & Bever, J. D., 2020). Arbuscular mycorrhizal (AM) fungi are an important group of soil microbes that form mutualistic associations with most prairie plant species usually found on the roots which can aid in plant growth and community composition by scavenging soil phosphorus in exchange for carbon from the plants (House, G. L., & Bever, J. D., 2020). This is important as instead of synthetic fertilizers used as nutrient amendments, we can now add this natural biofertilizer at the beginning of a prairie establishment project to help aid in plant growth.

The successful establishment of dominant C4 grasses is a common consequence of tallgrass prairie restorations, while the richness and abundance of forb species are often slow to recover, resulting in low plant diversity in restored communities (Schmitt McCain, K.N., 2008). In a paper published in 2008, a researcher examined aboveground and belowground responses to the removal of the dominant grasses in a restored prairie (Schmitt McCain, K.N., 2008). The findings showed that approaches such as reducing the abundance and cover of a dominant species while increasing canopy openness and light availability could gain subordinate forb species and increase plant species diversity in restored grasslands (Schmitt McCain, K.N., 2008). With this information, it is essential to make sure that in new tallgrass prairie establishments have different plant species to make sure the establishments are successful.

In a paper published in 2007, researchers looked at how biodiversity plays a vital role in achieving successful prairie restorations (Piper et al., 2007). They Examined the rate of establishment and diversity of grassland restorations where planted species richness and functional groups were varied to get an idea of the right number of species to add to a new tallgrass prairie establishment (Piper et al., 2007). They used 12 treatments consisting of (1,2,3,4,8,12) and 16 species mixtures of native perennials representing four functional groups; C4 grasses, C3 grasses, nitrogen-fixing species, and late-flowering composites that represented Central plains tallgrass prairie (Piper et al., 2007). Findings showed that total species richness and rate of establishment for each plot were higher with the most species richness mixtures than with the targeted species due to the emergence of natural species in the area (Piper et al., 2007). There were also found to be no added benefits among treatments that had more than eight species (Piper et al., 2007). Overall, results suggest that the establishment of smaller species richness in prairie communities can be enhanced by starting with more species richness and that benefits do not increase above eight species mixtures (Piper et al., 2007). The higher richness of species or functional groups should lead to a speedier establishment and greater resistance to the invasion of other species over a longer period when setting up a tallgrass prairie establishment (Piper et al., 2007).

Management

There are many management practices implemented to ensure the sustainability of the site, and many of them are used in combination. The two most applicable to our site are mowing and haying, which are typically used in conjunction with each other. According to Rowe (2010), mowing was used most often in the first couple years of managing the site to decrease the competition for sunlight and can promote native forbs while eliminating invasive species and control woody encroachment. Mowing too regularly could significantly lower plant diversity due to impacting some plants more than others (Chin & Harmon-Threatt, 2016). The timing of when to mow is also important. It is important to not remove flowering heads so the plants can disperse seeds as well as affect pollinators (Chin & Harmon-Threatt, 2016), although this can also eliminate invasive species from spreading as well (Rowe, 2010). Since mowing does not remove plant litter, it can stunt new plants from growing, which can negatively affect the sustainability of the site (Zhu et al, 2020). For our site, it would make management easier for maintenance, so it could be a viable option, but we would have to take precautions if we use this method. Haying can typically be completed at any time of the year, but the timing of haying can cause disruption to flowering plants or old plants could cause a decrease in forb diversity (Chin & Harmon-Threatt, 2016). Haying also caused a drastic decline in the Enhanced Vegetation Index (EVI) after harvest but also caused rapid regrowth of prairie grasses and rapid increase of EVI within a month of harvest (Wagle et al., 2019). The regrowth of uniform vegetation also caused a rapid increase in Carbon due to the newer vegetation that have higher rates of photosynthesis compared to older leaves (Wagle et al., 2019).

Prairie restoration sites require vigilant maintenance to ensure the integrity of the site. The largest threats to restoration sites are invasive species, woody encroachment, and increased vulnerability due to fragmentation (Rowe, 2010). Management in urban areas typically favor smaller sites, but there is the higher risk of prairie extinction due to the smaller area. The largest threat to a prairie restoration site is invasive plant species that can overtake a site if management practices are not used. Management practices are necessary to ensure the longevity of a site, because studies on passive prairie restorations fail due to invasive species and woody encroachment overtaking the area (Mutch, 2008). Tree saplings must also be managed quickly because they can block the sunlight and change the composition of the site by altering access to sunlight.

Smaller sites typically found in urban areas are typically smaller and are more fragmented than in rural areas. Smaller sites have the propensity to have higher extinction rates which reduces the native forb population and seeds (Mutch, 2008). Urban sites are fragile and can easily shift towards extinction if there are any dramatic changes to the environment (Mutch, 2008). There is also a human factor to consider since our site is on-campus. We need to ensure that paths are clearly marked, and people are aware of the restoration site so they do not accidentally destroy the vegetation, because the site could be damaged easily.

Public Engagement and Promotional Strategies

For the restoration site, it is imperative that the public is aware of its importance and the benefits they will receive. On K-State's campus, we envision various departments utilizing this tallgrass site, as well as potential students and alumni. The way to gain momentum for this project is through public engagement and promotional strategies. Public engagement is derived from environmental interpretation. Topics discussed under this include concepts of visitor use management through the use of signage, and the impact of centralize visitor centers in natural areas. The promotional strategies discussed are based on urban branding and reframing K-State identity.

Public Engagement

Visitor-use management falls under the scope of environmental interpretation because it is a result of effective environmental interpretation. One of the most common ways to communicate information in natural areas is through signage. Signage that includes pictograms tend to be the most effective. Signs that contain a "wall of text" are less effective because people do not generally want to read an entire paragraph about a natural feature, but rather prefer brief statements accompanied by pictures. Visual perception includes many areas in the human brain. It includes more than 80% and the sense of hearing is followed at 10% (Clara, S., & Swasty, W., 2017). This can be challenging when features of a natural area cannot simply be summed up in a few words, but instead need more information. A balance and compromise must be struck in these cases. An example of effective signage are road signs. There are typically minimal words and symbols. In the case of environmental signage, images such as a tree or a geographical location accompanied by minimal words can be an effective means at communicating information.

Visitor centers can play a large role in effective environmental interpretation. In terms of the ‘visitor center’, we envisioned the Berney Family Welcome Center as a place that would have advertisements regarding the restoration site, along with the already existing site. Simple exhibits would include the history of the site and why the restoration project exists. These exhibits would be good sources to include at the visitor center and on-site in the form of a small, easily digestible sign. They can also instill positive feelings about the site and nature if designed effectively. “It may well be that as people increase their positive feelings toward nature, their connectedness to nature increases. Connectedness seems to be increased by experiential learning where a person is in direct contact with nature. Therefore, immersion exhibits, animal programs, and positive real-world experiences such as walks and hikes, could all foster connectedness to nature” (Pennisi L. et al, 2017). The foundations of environmental interpretation are evaluating the reactions of visitors to natural areas to understand the influence over visitor behavior. With effective signage and educational resources in place like a visitor center, we can measure the behavioral effects of these implementations.

Promotional Strategies

A brand image is a person's current view about a brand; an overall impression in someone's mind that formed from all sources (Rehan, 2014). When it comes to green spaces, there are two types of branding: place branding and urban branding. Both strategies can bring more users into the green space because its nature invokes positive associations and loyalty which will generate regular use (Hewett, 2007). By implementing this tallgrass site analysis, we are hoping to get the same response as the Beach Museum’s Meadow. Students retreat to the Meadow to take a break from school and recharge outdoors. Inviting people to help with the management and maintenance of the green spaces turns into long-term stewardship. While it is still unknown how the tallgrass site will be managed, the Meadow is maintained by volunteer groups.

Urban branding is a new approach toward the urban development of cities. Urban branding is defining the physical features of the city and capturing the essence of the place (Rehan, 2014). We believe this could be implemented on K-State's campus. A key component of urban green infrastructure is the delivery, management, and enhancement of green resources such as urban parks, urban forests, and open spaces (Gulsrud, 2015). As seen in Figure 15, it is a process of diversification where local tourism organizations, art and cultural facilities, museums, and historic preservation groups construct place images. Currently, the Meadow by the Beach Museum is an area known on campus for relaxation and educational purposes. We have the same goals for a tallgrass restoration site.

Figure 15: Branding Strategies for Promoting City Image (Rehan, 2014)

The goal is to attract patrons and investments to a particular local area. Urban branding aims to develop new ways of communicating city image to the rest of the region and strengthen the reputation of the city and corporate identity. It should encompass the main things people should know about a place (Rehan, 2014). K-State is predominantly known as an agricultural school and attracts many agricultural students. However, after meetings with the K-State Sustainability Coalition, we found they wanted to reframe K-State's identity. Two themes were prevalent: The Tallgrass University and The University on the Prairie. This new identity can be accomplished if the first tallgrass restoration site is a success. The more sites integrated on campus; the stronger brand identity of the Tallgrass University will come through. K-State has strong agronomy, geography, and biology departments that would be connected to this site. By showcasing the restoration sites on campus, it will draw students to want to research at K-State and in the Flint Hills.

Conclusion

Tallgrass prairie is the most depleted ecosystem in North America, with just 2% to 3% of the original biome left (Smith et al., 2010). Even if the original prairie will never be rebuilt, tallgrass prairie restoration offers a chance to successfully undo environmental damage and preserve the essential biological features of this abandoned ecosystem (Smith et al., 2010). As human populations rise, urban areas are also growing. The implementation of these urban areas are leading to a decline in native landscapes. The implementation of restoration projects at various scales in the urban area can help mitigate the effects of urban systems (Bertram & Rehdanz, 2015). This has led to K-State assembling a sustainability coalition and supporting research group to begin its own efforts. After conducting an initial GIS land suitability analysis to narrow our potential sites to a more manageable level, further soil analysis was conducted for initial candidates to continue ruling out sites that don't rank high on desirability. With each step reducing the number of candidates, next, a survey was sent to stakeholders in the project to gather their opinions, and finally, the remaining candidates were fed through a decision matrix to identify the best and worst. The most suitable site we found was the Regnier Hall lawn. It's current conditions most closely resemble what we researched to be optimal conditions to restore into a tallgrass prairie. With an emphasis on the restoration site as an educational tool for the university and Manhattan community, Regnier site has shown to be our best option. At its location, it will provide these services to the widest range of users based on its central location. Understanding the elements of environmental interpretation, as well as the implications for health and wellbeing and sustainability are important in measuring the success of this project. If the first tallgrass restoration site is a success, we are hoping to implement more of these urban green spaces on campus. With more restoration sites on campus, we are hoping to attract new students and researchers in hopes that they gain knowledge and understanding of environmental risks and an increase in acceptance for prairie conservation This will result in K-State's campus brand image to transition from an agricultural school to “The Tallgrass University”.

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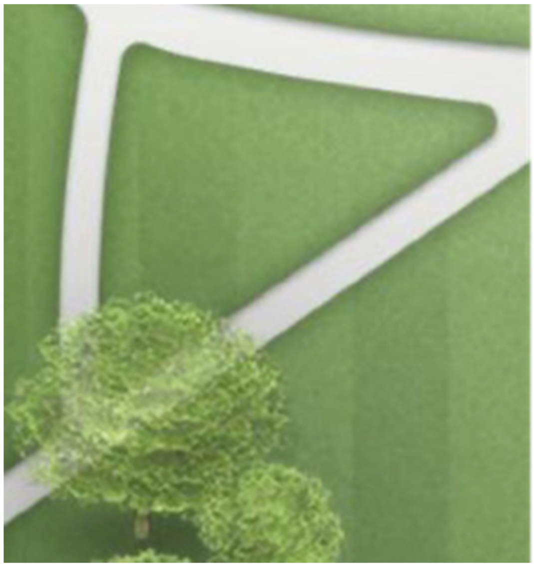
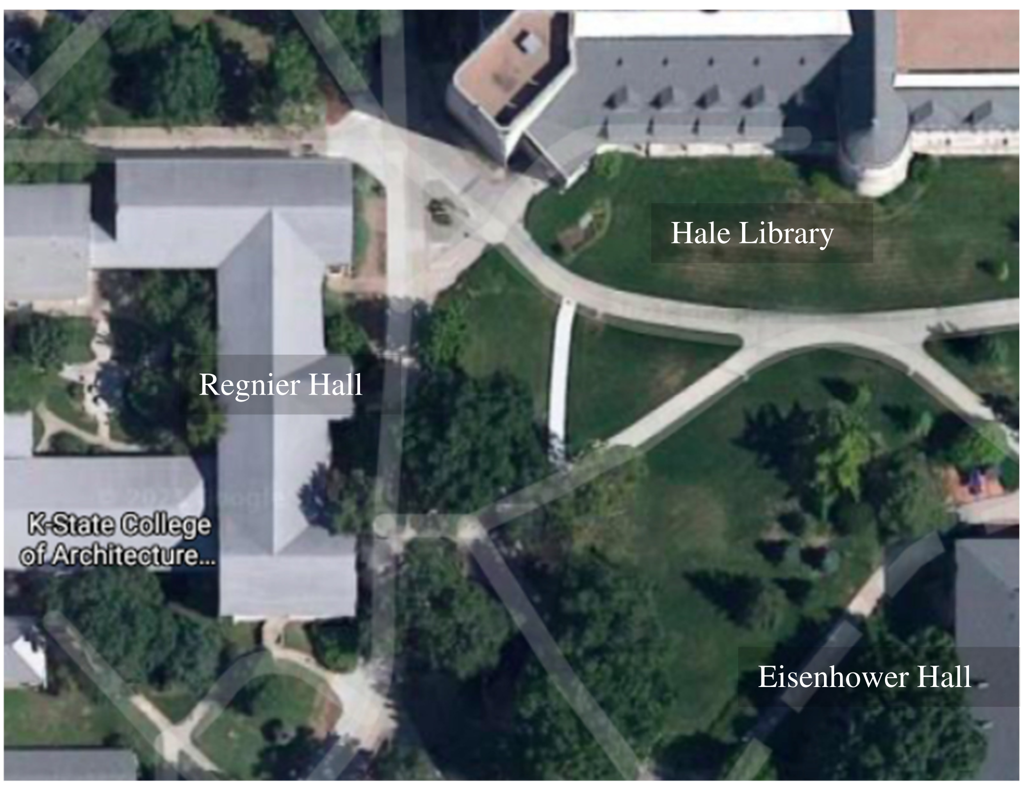
Appendix A. Site Descriptions

Regnier Hall Lawn



Size (ft²)	6364.61
Perimeter Est (ft)	372.14
Average Slope	2.31%
Percent Canopy	30.21%
Lights #	7
Current Land Use	Turfgrass
Parking Lot	Far
Bus Stop	Far
Sidewalk	Immediate
Educational Buildings	Library, Seaton, Eisenhower, Union
Noise	Medium
Pedestrian Traffic	High
Visibility	High

Site Context



(Google, n.d.)

Chalmers Hall Lawn

Size (ft²)	19305.23
Perimeter Est (ft)	752.69
Average Slope	4.30%
Percent Canopy	11.30%
Lights #	6
Current Land Use	Turfgrass
Parking Lot	Close
Bus Stop	Far
Sidewalk	Immediate
Educational Buildings	Ackert, Throckmorton
Noise	Medium
Pedestrian Traffic	High
Visibility	Medium

Site Context

(Google, n.d.)

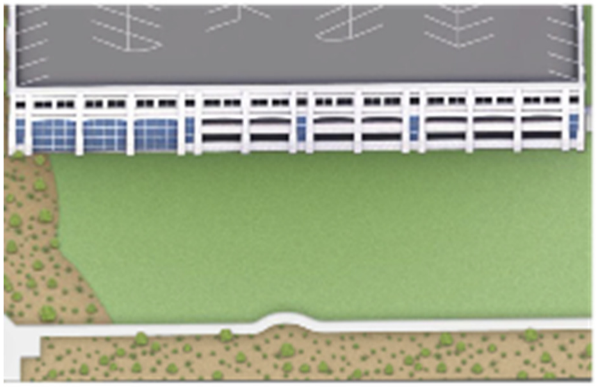
East 1/3 Anderson Lawn

Size (ft²)	47605.74
Perimeter Est (ft)	1242.18
Average Slope	3.74%
Percent Canopy	62.13%
Lights #	4
Current Land Use	Turfgrass/ Woodland
Parking Lot	Close
Bus Stop	Close
Sidewalk	Immediate
Educational Buildings	Anderson, McCain, Library, Business
Noise	Medium
Pedestrian Traffic	High
Visibility	Medium

Site Context

(Google, n.d.)

S. Union Parking Garage



Size (ft^2)	9219.48
Perimeter Est (ft)	604.89
Average Slope	1.06%
Percent Canopy	0.00%
Lights #	0
Current Land Use	Turfgrass
Parking Lot	Immediate
Bus Stop	Close
Sidewalk	Immediate
Notable Buildings	Memorial Stadium, Union
Noise	Loud
Pedestrian Traffic	Medium
Visibility	High

Site Context

(Google, n.d.)

Chester E. Peters Recreation Complex

Size (ft²)	58035.22
Perimeter Est (ft)	950.36
Average Slope	3.09%
Percent Canopy	0.00%
Lights #	0
Current Land Use	Turfgrass
Parking Lot	Immediate
Bus Stop	Close
Sidewalk	Immediate
Educational Buildings	Bill Snyder, Jardine Apartments
Noise	Medium
Pedestrian Traffic	Medium
Visibility	High

Site Context

(Google, n.d.)

Veterinary Medicine Coles Hall

Size (ft^2)	154030.58
Perimeter Est (ft)	2183.84
Average Slope	4.32%
Percent Canopy	32.87%
Lights #	0
Current Land Use	Turfgrass/ Creek
Parking Lot	Close
Bus Stop	Far
Sidewalk	Immediate
Educational Buildings	Vet School, University Gardens
Noise	Medium
Pedestrian Traffic	Low
Visibility	High

Site Context

(Google, n.d.)