COLLISION COURSE
Leveraging Open Space Conservation and Public Education to Minimize Bald Eagle Aircraft Strikes in St. Paul, Minnesota
THESIS ARCHIVAL NOTE

The following thesis project, entitled COLLISION COURSE: Leveraging Open Space Conservation and Public Education to Minimize Bald Eagle Aircraft Strikes in St. Paul, Minnesota, was composed over the course of the 2017-2018 academic school year. The Thesis Program, as contained here, was initiated and completed in the fall semester as a part of the LA 563: Programming and Thesis Preparation course. Supplemental material, including the Thesis Boards and the Thesis Presentation documents, were generated in the spring semester as a part of the LA 572: Design Thesis studio. Any inconsistencies between the different documents, in terms of research and design, should be excused per the evolution of the project across the two semesters.
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While many of us travel on an airplane day to day, the responsibility that pilots take on from boarding to deboarding is intensely high. Many considerable things could go wrong, and being responsible for many lives puts tremendous pressure upon pilots. Common collisions with wildlife and airplanes have caused many complications. The consideration of airport layouts and their surroundings could help lower the risk of endangering the lives of humans and wildlife. Specifically looking into Bald Eagles at the St. Paul downtown airport, implementing bird habitats around the airport that include human traffic could help control flying and landing patterns of America’s bird while giving more usable space for St. Paul’s citizens. In doing so, yearly collisions between airplanes and the birds may decrease and provide greater safety for humans and birds alike.

Understanding the behavior of eagles and how they react to certain types of habitat are important to the design process for this thesis. Implementing hunting grounds and sought after habitat by Bald Eagles in conjunction with the take off and landing patterns of planes attempts to delete the crossing of paths between the two.

As a whole, the amount of incidents reported (which are reported as ‘wildlife strikes’) in the Minneapolis-Saint Paul area was 115 in 2015, and 126 in 2014 according to the Aviation Safety Network [5]. At the St. Paul Downtown Airport, 5 of those incidents were reported in 2014, and 7 were reported in 2015 [7]. Although, the StarTribune newspaper based out of St. Paul, Minnesota wrote that only around 20% of wildlife strikes were actually reported around the United States [8].
I remember my mother coming home from work one day, talking about how another Bald Eagle was hit on the runway at the St. Paul airport where she works. A grotesque and slightly upsetting story about the impact between the airplane and the eagle really made me feel bad for the bird, or frankly, what was left of it. Hearing her and my father discuss how there are no ways to combat eagles sitting on the runways got me to start thinking about what could be done. Could something be done? What made the runways and airport so appealing to the birds that they just wish to sit there and not move? I decided to tackle this in my thesis.

Being an avid hunter and fisherman, conservation is always one of my top priorities. The conservation of all species is important to make sure that our ecosystems are well taken care of, balanced, and healthy. We are only here for a short amount of time. Conservation efforts ensure that there are opportunities for future generations to enjoy connecting to nature and providing protection for species around the globe.

“We Don’t Inherit the Earth from our Ancestors, We Borrow it from our Children.”
-Native American Proverb-
The St. Paul downtown airport is surrounded by the Mississippi River to the North and East. Looking into the conservation of Bald Eagles and ecological design that's based upon the behavioral patterns of eagles and airplanes could benefit the city of St. Paul and provide better safety for humans and animals alike. Creating public usable space to allow access to the river, while integrating into the conservation land, designs for several types of usability. The typology of animal control may not be common, but the interconnection of different typologies in this thesis overlays many different benefits. An example of this would be design walkable boardwalks around the designated Bald Eagle hunting grounds to minimize human disturbance in the landscape while allowing walkable areas and usable space for pedestrians. Animal Control, Conservation, waterfront redevelopment and park and open space are all typologies issued in this thesis. A mix between all of these underlay over the hierarchy of Animal Control in this project.
The Major Project Elements for this site are:

1. Bald Eagle habitat and nesting zones
2. Hunting grounds and open fields
3. Habitat for other native wildlife species
   By providing habitat for other species, population of Bald Eagle’s common prey will have a chance to grow and live to draw Eagles to hunt these areas.
4. Riverfront access to the public
5. Parking
6. Canoe and Kayak launch stations
7. Public walkways and educational zones
   The public walkways will be elevated and closed off to the habitats and hunting zones to minimize human disturbance into these areas.
8. Educational Signage
   Educational zones and interpretive signage will provide information and knowledge to the public about the importance of the reducing wildlife strikes.
9. Public gathering spaces for crowds
The main client for this thesis is the city of St Paul in Minnesota. As being the owner of the St. Paul Downtown Airport and the surrounding public spaces along the surrounding Mississippi River, the city will need to be the main source of funding. The main requirements will be to develop a safe surrounding area for Bald Eagles and airplanes that are using the airport at all times of the day. These habitat spaces will need to be able to accommodate for the population of the surrounding Bald Eagles. In the sense of the public, the parts of the design that will be open to the people will be able to hold around a couple hundred users by providing spaces for public gatherings. Giving spaces for the pedestrians to use the river front access and learning about their wishes for water access will also be viable to the project.
Site Information

Located to the East of highway 52 along the Mississippi River in downtown St. Paul the airport consists of a smaller jet facility open to the public and national guard air base. This 576 acre site is located 705 feet above sea level and has been open since April of 1940. The airport has 3 runways and has had a flood wall installed in 2008. Municipal forest and Battle Creek regional park are located to the East of the airport, this area will be the main design area of my thesis.

I chose this site on the basis that this is where I first learned about the problem and have heard about it happening for years. It’s relatively close to home for me, and a smaller airport with low amounts of civilian numbers flying into the site feels to be a better study area that if deemed successful could be replicated to larger airports. Also, the collision with birds between smaller private jets would cause more of a damaging and dangerous outcome to the airplane and the safety of the crew compared to larger planes. A large incentive was also because it is bordered by the Mississippi River on almost 3 full sides. Including a new design along the riverbank that can be used by civilians along with doubling as conservation and collision prevention is a good characteristic to this site. The fact that Bald Eagles enjoy and live off the wildlife and environment around water bodies also put the icing on the cake for the site decision.
The emphasis for this project is to discover and express the danger of the collisions between the birds and airplanes. Stepping up to show how safety can be increased for both humans and animals, and requiring less maintenance costs for airplanes is an important aspect in this project. By providing and supporting natural bird habitats that are usable among the public, it expresses there are safe ways to reduce and deplete wildlife strikes if the study proves successful. By choosing a site in an urban setting, it is a hope that it is possible to emphasize the synthesis of urban and conservation settings are possible and a good thing for the safety of the wildlife and people. Also, expressing educational aspects into the site will show the public how important it is to decrease wildlife strikes, create habitat within a city, and to try to have the lives of people and wildlife co-exist in cities all over the country.
Goals:

**Academic**
1. To increase the understanding of how to develop airport layouts with the intent of wildlife strike reductions.
2. Incorporate sets of goals that can be replicated and modified to adapt to different environments and species.

**Professional**
1. Create and set certain standards to be reached in the design of public airports and airspaces for firms.
2. For environmental challenges to be sought and thought upon for conservation efforts in an urban setting.
3. To help create a thought process of the co-existence between human, animal, and machine.

**Personal**
1. To provide protective areas and hunting grounds for Bald Eagles.
2. Decrease crossover paths between common bald eagle flight patterns and airplane fly ways.
3. Allow for low human impact circulation into the park and conservation system using boardwalks and fencing.
4. Create river access and public park space as an educational and recreational area for the public to enjoy.

**Main Goal:** Reduce collisions between Bald Eagles a Air Planes.
Goals

The goals outlined in this program express the main points that is hoped to be obtained in this design study. On an academic standpoint, I take this as the view in which I would hope someone could use my thesis as a case study for their academic achievements. In reading this study, one may be able to develop ideas on how to look into the development of airport and their design while taking into effect the wildlife species that inhabit the area and how low impact ratings could help the airport economically and create better safety for pilots, passengers, and wildlife. By setting out goals that are important to try and follow and reach, these can be replicated and modified to fit the surrounding area, climate, and wildlife in the area.

On a professional standpoint, standards may be outlined in an attempt to have these goals reached for better development of airspace. Environmental challenges could be sought after to push conservation efforts in an urban setting, instead of separating wildlife conservation land and urban environments. Perhaps combining the two could be reached for better designs around the world for all species. Reaching into the last professional goal of creating a co-existence between humans, wildlife and machines could we push for a better world in the future of design.

On a set of personal goals for this project, the designation of protective areas and hunting grounds for Bald Eagles could be a big asset to providing safety for all life in the area. By designating these areas, leading eagles away from runways and airplane takeoff and landing zones may help with collision reduction around the site area. While this is a large focus on safety, allowing human interaction into the site is also important. The separation between bald eagles and humans may be essential in the overall effectiveness in the hypothesis of this study. By creating river access and public space, educational aspects could help spread awareness of the issue to the public while also giving recreational enjoyment to the citizens of the city.

The key factor to remember in this study, is to reduce the collisions between the Bald Eagles with airplanes in the site, and provide educational aspects that could be incorporated into future designs.
O’Hare Airport

O’Hare International Airport in Chicago, Illinois is an 11.25 square mile airspace West of Lake Michigan with integration of retention ponds, on-site creeks, and bordered by Catherine Chevalier Woods to the East. This airspace has developed over years to introduce animal control and habitat in an attempt to reduce wildlife strikes throughout the area. With O’Hare being one of the most busy airports in the world, collisions with wildlife could cause some serious issues and danger to many lives.

In 1992, two biologists from the U.S. Department of Agriculture were hired to help monitor the wildlife around the airport area to reduce wildlife strikes. Their mission was to increase safety and demotivate geese, ducks and seagulls, among other bird species, from wanting to use the airport as feeding and breeding zones. Policies and measurements were introduced while also training Airport Operations staff to handle the situations safe and effectively. Lethal options were also permitted if it deemed necessary for the safety of planes and passengers. The on-site retention ponds are needed for on site water removal to reduce flooding around the airport. Drainage of these ponds enter into two nearby creeks to travel south away from the airport.

Key components designated by the two biologists were to exclude ponds and streams that attract birds into the area. For the retention ponds that are in the site, kevlar liners deplete accessibility to the water for birds. A large retention pond, named “Lake O’Hare” on the airport has it’s water level adjusted and managed to reduce natural vegetation and invertebrates from developing in the water. Garbage bins, natural feeding vegetation for ducks and geese, and lampposts are also excluded from the site to decrease the attractiveness for bird species and wildlife. If birds are brought to the site, then harassment and the last resort of lethal means are used to remove species from the area.

On a social and economic standpoint the management of the habitat and land characteristics in the site have depleted wildlife strikes at the O’Hare airport. Reducing wildlife strikes have caused greater safety for people and birds. Along with safety, economically, creating wildlife habitat also reduces the repair costs associated with damage sustained from impacts. In 1998, there were 94 reported incidents of wildlife strikes at O’Hare airport, while in 2015 there were 302 reported strikes. While the number of incidents did increase, there is a larger number of airplanes being used today then there were in 1998 which increases the chance for collisions. As an example, the difference in the total number of passengers flying into and out from O’Hare airport in 2015 is a little over 4.6 millions passengers more than the total number of passengers recorded in 1998.
O’Hare Airport Components to take away from this study:

1. Reduce the amount of attractive habitat for Bald Eagles and other species on the airport grounds.

2. Increase attractive habitat around the airport grounds to draw species away.

3. Decrease garbage and other scavenging pieces for birds.

4. Introduce new ways of harassment for a final option to push eagles off runways temporarily.

Figure 3: O’Hare International Airport Map

Figure 4: Construction of water spillway to flow water away from O’Hare airport grounds
JFK Airport

The JFK International Airport sits South of Queens and East of Brooklyn in New York City, New York. JFK is a huge airport, covering a whopping 4,930 acres, along with 30 miles of roadways on the site. Sitting on the Northeast side of Jamaica Bay, it reaches about 4 kilometers from the Atlantic Ocean. Many tactics have to be used at JFK airport, especially starting from 1985 and onwards.

Jamaica Bay makes up 100 percent of the shoreline of JFK airport. Approximately 9000 acres set aside in Jamaica Bay is a designated wildlife refuge. This wildlife refuge is home to a large number of bird species, with the majority being aquatic such as seagulls and waterfowl. This is due to the majority of the wildlife refuge consisting of water and islands that houses benefits and characteristics needed for aquatic bird species. These characteristics include marshes, open water of both fresh and salt water, and aquatic plant species. Although, with this refuge comes great affects, such as 50 percent of the bird species that are affected by wildlife strikes are seagulls. Canadian Geese are considered a large threat due to their size, even though they seldom have strikes with airplanes possibly due to high altitudes of flight during migration. Apparently, during the daytime is when the majority of wildlife strikes actually occur, and at very low altitudes, measured to roughly be from 0 to 30 meters off the ground [2].

With this wildlife refuge being so close to the airport, the consideration of it’s design is something to be pondered. One of the main runways is directed straight at the wildlife refuge just off shore. Tactics needed to be taken to help avoid wildlife strikes in such a popular airport. A bird control team were quickly introduced to the airport. The tactics used for bird control pushes more on the harassment and lethal side in comparison to conservation efforts. The main tactics used are harassment, falconry efforts, gas cannons and shooting of the species. Although, to help, garbage dump designs have been implemented to make sure the garbage is covered to reduce bird temptations. Shooting was one of the main tactics used, but falconry has been progressing more and more to take over the lethal tactic.

On a economic standpoint, again the depletion of wildlife strikes helps save money on repair reduction and other money spending needs. Environmentally, the killing of wildlife and harassment of birds do not exercise good environmental tactics. Keeping the wildlife refuge along the airport keeps a good environmental standing for wildlife, but the airport could possibly look into other designs to decrease the crossover of wildlife and takeoff and landing zones.
Components to take away from this study:

1. Keeping and creating wildlife zones and refuges benefits birds and their populations

2. Understanding and designing garbage dumps and other bird attractants around the site to become less arresting to bird species on and close to the site. Finding what food source Bald Eagles are eating around the airport grounds will be important to reduce the drawing power in the property.

3. Try to reduce the need for fatal and harassment tactics and base more on environmental tactics.

4. Don’t point runway and landing strips toward designated bird habitats.

In the comparison of O'Hare airport, JFK focused more on lethal and harassment tactics than design tactics on airport grounds. A large difference between the two is that JFK resides directly next to a wildlife refuge, while O'Hare is engulfed by an urban environment. On the similarities, both airports focused on what was attracting birds to the site, and how to find ways to decrease the effect these attractants had. Garbage seems to be a major key feature to look at in my site area.
Jackson Park redesign sits on the Eastern side of Chicago, Illinois along the Lake Michigan shoreline. There was a 3 acre restoration design that was implemented in 2004, and 4.1 acre restoration design implemented in 2010 along with a 6 acres of ecological restoration for aquatic species and environments. South Lake Shore Drive was in need for a restoration process to be usable to the public and to control rising water levels from the Lake Michigan shore. There was an opportunity to include an ecological landscape design along with the restoration. The Park District of Chicago wanted to develop lake shore across the city of Chicago and this was a perfect opportunity.

Designed by Terry Guen Design Associates, this landscape architecture firm studied the historical aspect of the site, and the ecological value of the area and what it needs. Interestingly, the designers did not want to replicate the original wetland that was already there, but instead decided to develop plantings of grasses that could sustain waves from Lake Michigan, along with heavy continuous winds. The site also needed to update new pedestrian circulation around the area to upgrade from the old design of Jackson Park.

Originally, the waterfront wasn’t a thought in the redesign for the area. The Landscape Review Committee was in need to be persuaded by the firm to design a new beach front, and they accepted. With the beach front design, swimming bans were starting to deplete, and were decreased by 72% along with swim advisory days by 62%. The grassland areas provided many benefits to the site. It lowered erosion on the beach by 100%, and in 2004 was estimated to have saved 450,000 gallons of drinkable water. From a wildlife perspective, by designing the grassland along the lake shore the architects ended up creating usable habitat for over 200 bird species including raptors.

On a social standpoint, the redesign of the pathways into the area has increased learning and better circulation around the area. The Shedd Aquarium also developed learning activities for the area, and hold stewardship days for and educational aspect that also brings in the use of 200 volunteers each year ever since the redesign in 2004. By integrating human traffic into the site, we can see that it’s possible to mix together human and bird populations from a successful design.
Components to take away from this study:

1. The integration of human and bird activity can be successful if properly designed.

2. The use of grasslands that can withstand waves and winds of the area can be useful to helping erosion and maintain the natural landscape while providing habitat for many animals species.

3. Allowing water access to the site can attract many organizations and pedestrians to the area for water usage and events.
Plan for Proceeding

In the movement forward with this thesis project the study and understanding of Bald Eagle behaviors and habitats are essential. By studying and referencing projects and journals done about eagle behavior and their preferred wants and needs in life, the development of an oasis that will be too good to leave will be a large (and perhaps unattainable) goal to aim for. Studying the site and an effective site analysis will be important to ensure the correct locations of plantings, pedestrian areas, and air plane pattern among many other things. The studying of wind patterns and their shifts from summer to winter months will show where the majority of the takeoff and landings will face. Comparing these wind patterns to the air currents Bald Eagles typically fly and highlighting the crossover patterns between the two will find where there are high chances of collisions to occur.

The methodologies behind this study will be to find many studies that emphasize on bird hazards to aircrafts. The use of many studies and articles written on this subject will help legitimize and give credibility to my theories and findings used to make decisions on my design. Creating graphics to help understand and express my findings and solutions to readers will be viable to this study. The use of infographics and graphical maps and layouts in my site analysis and conclusions will help let outside readers understand what my findings are and how I used them to build into the design. After concepts have been developed, the use of rendering softwares and computer programs to build 3D renderings and sight plans will be used to express my ideas to the reader for easy understanding. An interview with my mother and her possible co-workers at the St. Paul Tower will be viable to hear what outside sources may want to be established in my proposed park system and what they see happen during wildlife collisions.

I would like this study to be made public and open to anyone who would like to follow the same typology in a design. To do this, I would save this study into a few different formats at the finish of this project. Scanning in ideas, taking pictures of drawings and keeping many of the design ideas and information I conjure up during this study will be saved and made accessible along with the final study paper and presentation. A final portfolio with all my work documented will be made accessible to incoming students, scholars, and future employers. I will set out completion dates to be followed for categories that are required in the study to maintain on course over the semester.
Plan for Proceeding

Weeks 1-2: Research and Find additional Case Studies

Weeks 3-4: Layout and Start Site Analysis
- Look into Climate, Transportation, and Land Use around the site

Weeks 5-6: Site Analysis and Thesis Manual
- Wind Currents, Airplane Flight Paths, Park Connections, etc.

Weeks 7-8: Site Analysis and Thesis Manual
- Theory, Technology, History of Site, Scenic Analysis

- Soils, Vegetation, Topography, Geospatial Analysis, and Flooding


Weeks 13-14: Concept Development
- Begin Developing Ideas with Bubble Diagramming and Spacing

Weeks 15-16: Concept Development
- Begin to Refine Spaces in a more Detailed Layout

Weeks 17-18: Detail and Finish Concept Development

Weeks 19-20: Draw Plan and Layout into AutoCAD Software

Weeks 21-22: 3D Rendering in SketchUp

Weeks 23-24: Lumion Renderings from 3D Model

Weeks 25-26: Finish Sections and Perspective Renderings

Weeks 27-29: Build Thesis Presentation and Practice

Week 29: Present and Finish
- Print and Online Submittal
There happens to be a lot of good facts and information that was highly needed in proceeding on with this thesis. When I was wondering what could have been done about Bald Eagles being hit I had a few ideas right off the bat, but my ideas have tripled with newer goals to meet and ideas to exercise. This project could present a lot of good ideas and ways to help preserve our nature’s wildlife, and find a way to better co-exist with the animals and landscape, over attempting to separate the two.

This form of architectural theory that’s at practice in this thesis idea is the typology of wildlife control. Although this is the main goal, other smaller forms of design will be administered in this project. With wildlife control at the helm as the target objective, other forms of typology are to be integrated as well to make a better design. These typologies include wetland design and restoration, wildlife conservation, habitat conservation, public park space, airport redesign and industrial site remediation. If all these types can be integrated together under the purpose to help control wildlife, then people and wildlife can enjoy these areas together in harmony.

The economic problems behind wildlife strikes have been a problem that can be solved with the reduction of wildlife strikes. By reducing wildlife strikes the high cost of airplane repairs and wildlife licenses needed to take bird species can be depleted. By integrating an educational wildlife center that can be used to educate the public on the problem, then persuasion could be used to ask for donations from the public for funding to help maintain the park designs and eagle habitat.

The art of conservation is important, especially in today’s world. Many airports that have looked at ways to keep birds off airport don’t necessarily deplete the natural vegetation around the airport, but instead leave it and even attempt to rebuild it. Although, the natural vegetation on the airport grounds is usually looked at as a nuisance since it attracts certain species. These areas are becoming managed by biologists and airport personnel.
This research article has studied the Oribi Airport in South Africa and their problems with wildlife strikes occurring from birds. This research study has taken an extensive look at the problems that have arisen and the environment of the situation that the airport is currently facing. What will be covered in this review will be the components that the authors have studied from the airport to draw their conclusions. The specific bird species that have been studied, the current and proposed tactics that were stated in the article, a review of the airport, and their expressive ideas to decrease wildlife strikes will be stated. This research study proposed many good ideas that are adaptive to my area while being expressive in my thesis.

**Oribi Airport**

The Oribi Airport has had problems with the presence of bird species for years. In the research article, the two specific bird species mentioned to be the greatest threat and accumulated the most collisions with airplanes were the Hadeda Ibis and Crowned Plover. One of the main problems with the Oribi Airport is the over-abundance of grassland on the airport grounds. Also, the surrounding of agricultural land, and the bordering of a nature reserve in which bird species are protected on, provided huge amounts of easily accessible habitat. Described in the article, there have been a large amount of bird strikes that have occurred at South African airports. Oribi Airport is smaller to others in South Africa, but it has been noted that it is the airport with the most recorded wildlife strikes in the country. It was stated that an average of one wildlife strike ended up occurring every 18 days. The main reasoning behind this study was to research, understand, and predict common bird movements at and around the Oribi Airport. Byron and Downs decided to focus on the bird movements of the targeted species pointed out before, the Hadeda Ibis and Crowned Plover. A topographical map of the airport and surrounding area was issued in the study for the understanding of developed and undeveloped areas along with transportation and water runoff.
The Study

The study at the airport was proceeded for five months. These months consisted of July, August and September in 2000, and then repeated again during December of 2000 and January in 2001. One of the main tactics that was used during this study was to map the direction of flights that occurred from the two main researched species over the airport. While the direction and pathways were mapped, the researchers also recorded the estimated heights that the birds were flying. During the study, the researchers decided to divide the only runway on the airport into three separate sections. The runway consisted of a total length of 1800 meters. Byron and Downs divided the runways an even 600 meters a piece and labeled them as the “Start”, “Middle”, and “End”. The study looked at the number of strikes that occurred in the three sections to see where the majority of the collisions on the airport ended up happening on the runway. While Hadeda Ibis and Crowned Plover were the two main bird species studied at Oribi, a list of the all the bird species flying over the airport were recorded and listed to compared. How the researchers recorded this data was using binoculars and birdwatching from the airport control tower, and from walking around and recording observations around the airport property. More information on the bird species on the airport grounds were obtained from an external source listed from M. Brown.

While the researchers studied parts of the airport themselves, they also recorded information taken from pilots that used Oribi Airport during the time of the study. They kept track of information that couldn’t be discredited to the public, but they used this information to record and understand the wildlife strikes that occurred during takeoff and landing to see if there was a difference between the two instances. Along with the information taken during takeoff and landing, the researchers recorded if these strikes occurred during morning or night time and if there was a correlation between occasions. Actual interviews with the pilots had to occur as many of the data sheets were not being fully filled out after strikes happened, thus possibly skewing the data.

The Results

There were many interesting points to take away from this study. Starting, a total of 72 bird species were recorded from observation studies at the airport. Apparently, over half of these birds were relatively small and weighed less than 60 grams.
which is less than a quarter of a pound in total. Interestingly though, lower numbers of bird species were recorded during the summer months. Comparative to summer, there was a significant jump in the number of birds recorded at the airport per hour during the winter months. Not only was there a difference in total birds seen, but the species recorded ended up differing. Crowned Plovers ended up being recorded on the airport grounds throughout the summer and winter months, but mainly in the winter months. Plovers were recorded to be resting on the grounds, or feeding. Apparently, many of the Plovers seem to have adapted to the winds and sounds of the airplanes taking off and landing and weren’t very wary of the machines.

As for the Hadeda Ibis, there numbers were average with the other bird species recorded during the summer months. Apparently, raptor species were the greater number of bird recordings during the summer. Although, during the winter months, the Hadeda Ibis were the most common of the bird species recorded. Interestingly though, they were the greatest number of birds in the morning and in the afternoon. According to the study, the highest number of Ibis recorded at the airport was reached in July and totaled 120 birds per hour. Although, during September the number dropped to roughly 70 Hadeda Ibis per hour. One thing to remember is that in respect to my study, South Africa’s winter months consist of June, July and August.

The sun affected the activity of the bird species and their abundance on the grounds. The number of Hadeda Ibis during sunrise and sunset, as well as 30 minutes before and after sunset. The activity of the birds followed the sunrise and sunset times and changed during the summer and winter months with the sun patterns. During mid-day, many of the sightings decreased significantly until the evening and dusk at the end of the day. Pilots, as stated earlier, took recordings of data too but didn’t deem to be fully credible. Data recorded from the pilots is confidential so the actual information given is hidden, but a few conclusions have been drawn from this piece of research. Pilots were interviewed to better understand the collisions that occur at what stages of airport activity. Percentages were calculated to see if the majority of strikes were occurring during takeoff or landing, and if they occurred more during the morning or night times. These pilots interviewed for the study reported that most of the wildlife strikes ended up occurring during the landing process in comparison to the take off. Although, it’s important to keep in mind that out of all the data made open to the study, only 13 of the reports included whether the strikes occurred at takeoff or landing. Adding on to this, 12 of the strikes were reported that the majority of the strikes happened
during the evening hours in compared to the morning hours. The two bird species that caused the most strikes were the Hadeda Ibis and the Crowned Plover.

This study has developed a few ideas to reduce wildlife strikes at the Oribi Airport. Studying and understanding the flight patterns and behaviors of the most common bird species affected by the airport is important. Also, taking care of the habitat and vegetation on the airport grounds themselves is beneficial. This study illustrates the importance of maintaining the grass areas on the airport to decrease food availability to certain bird species and other wildlife. Lethal tactics could be used, but were very unwanted and could not be used against the Hadeda Ibis as it is a protected bird species. Trees used for roosting around the airport increased the population of Ibis around the grounds, and it was reported that around up to 120 birds can roost in a single tree. 95% of these birds flying through and over the airport were coming from these roosting sites. It was suggested that removing these trees could force the Ibis to find alternate routes between roosting and feeding grounds. Overall, the idea of correct management, food, habitat, and water reduction on airport grounds would decrease the attractive personality of the airport for wildlife, and decrease populations at and on the grounds. These ideas are also the most popular from the public as it reduces the need for harassment and lethal tactics.
Summary

This study presented by Byron and Downs has given many things to think about. The study conducted took into effect over 70 birds species to study, but mainly focused on two of the most abundant species at the airport. I can take this idea and while my study is mainly focused on Bald Eagles, it would be beneficial to see if there are other bird species that cause wildlife strikes also. Attempting to reach out to pilots and get their opinions and observations on the matter would also help with my study to understand if Bald Eagles are mainly hit in the air, or on the runway and if these strikes occur more in the taking off or landing phase. I appreciated that this study focused on the environment and habitat on and surrounding the airport as a just cause for wildlife strikes occurring.

Understanding how to utilize habitat could provide more human tactics to be used and less often. Researching bird species during the morning, afternoon, and evening is a good tactic to be used for the understanding of bird flight patterns during the day and when they are most active around the area. I can use this idea to research and possibly understand when Bald Eagles are most active during which times of the day, and if there is a reoccuring pattern of when collisions with the birds at the St. Paul Airport. One piece that I found the be the most helpful and connecting to my study was the understanding of roosting trees next to the airport and how these effect the number of birds flying over and into the airport. It was stated that removal of these tress would cause birds to find an alternative roosting area and different flight paths away from the airport. Although, I would see this a beneficial but also destruction of natural habitat to all the wildlife species that use those trees. Perhaps, such as for my study, keeping and even increasing bird habitat around the airport, but aligning these areas with other hunting and feedings grounds could help draw the eagles away from intersecting points of airplane flight paths and greatly reduce their need to fly over the airport at all.

Taking these ideas issued in this study and adapting them to my site will be beneficial to my research thesis. These studies helped research and explain problems that have taken months to understand. While taking the characteristics of this article into account and understanding that the location, wildlife species, and climate are all different, the essence of the project is still beneficial and its research can be adapted to the current situation of this thesis. It also expresses that this problem isn’t only happening in North America, but in fact all over the world. Coming together in these studies and expressing these problems around the world can help address airport layouts in every country around the globe.
The U.S. Fish and Wildlife service issued a two page statement on the attempt to control birds at airports. In this article they state the legal status behind certain types of tactics that are used by airports around the country and the laws that must still be abided by. Interestingly, this article presents great definitions and reasonings behind what attracts birds to airports and how we can deem these to become unattractive. They break these down into five categories, starting with food, then water, shelter, local movements, and migrations. By expressing these five categories this article presents information of each and what to look for in the local area of your designated airport. After, it expresses two types of management plans and what we can do with each of these ideas to adapt them into our specific site. Most of these tactics put non-lethal ways first, then express how lethal tactics may need to be used as long as it abides by the federal and state laws and regulations.

Legal Status

Even if the airport targeted in a study is run by state and local governments with federal government aid, such as St. Paul Downtown Airport, these airports must still abide by the state and federal laws regulated to protect bird species. That involves birds that are causing a threat to airplane safety. Even for airports, all “migratory birds are protected under the Migratory Bird Treaty Act of 1918” (U.S. Fish and Wildlife Services). It is even stated that for bird species that are not considered to be federally migratory, nonmigratory bird species are protected by the State laws and can vary from state to state. The U.S. Fish and Wildlife Service declares that “Federal Law States that it is unlawful to hunt, kill, possess, or sell migratory birds except as permitted by regulations adopted by the Secretary of the Interior.” Even for airports, they must state and have proof that any bird species that is wished to be taken are actually a threat to public safety and can cause troublesome damage.
Although, it is also stated that while it may be proved that birds are causing a large safety concern, the applier for the permit must also prove that they have used and attempted nonlethal tactics that have been unsuccessful. It must also be applied through the state and a state permit must be acquired.

**Attractive Characteristics**

As stated earlier, a list of characteristics that birds are attracted to at an airport setting is illustrated well within this article. Understanding the basic biology of the site and the area is important to determine what types of environments and resources are available to the targeted birds species in a study. While some types of habitats may attract one bird, it may deter a different kind, and vice versa. One of the first steps stated is to determine the reasoning behind why birds are attracted to the airport and the surrounding grounds. By finding what characteristics these birds look for, then actions can be taken to make the airport and its surroundings less attractive to passing bird species. The research states that birds generally transpire to be at certain airport grounds because they provide food, water and shelter, the basic necessities of life. Also, when these airports are placed in migration movements and patterns, then large numbers of bird species are possible to end up in the vicinity and in the airspace.

Food is one of the largest characteristics that attract birds to an area. Open airfields surrounded by plantings and habitat provide many forms of food for many wildlife species. For birds, most of these food sources are in forms of seeds, insects and grubs, grasses, berries, and even other birds and wildlife for predatory species. If an airport is located near water, then fishing bird species, such as Bald Eagles, can become abundant at an airports grounds. Small rodents are also a major drawing force for predatory birds including Eagles, Hawks, Falcons, and Owls. It is also possible for food sources to be human made. Human activity and food can draw birds species around from littering, spare food scraps, and having personnel and passengers feed birds on and outside of airport grounds. Requiring and designing proper garbage disposals is important.
Maintaining garbage cans and building away from industrial sites, recycling centers, fishing ports and garbage dumps is crucial to deter bird species away from areas and make them less appealing.

Water is a major drawing force for animal species to an area. A clean water source with a healthy aquatic ecosystem relates to a healthy habitat of the area. A major problem that can occur for airports around the world is the amount of water adjacent to the site, and the occurring rainfall that can happen from season to season. Heavy rainfall seasons can cause high water levels for temporary stormwater pools on airport grounds. If left unmanaged, these pools can sit for long periods of time and attract many types of bird species. If these ponds are left unmanaged, birds will be seen loafing in the area for freshwater and even feeding on the opportunities of aquatic species and vegetation that can develop. Some airport designs around the world even incorporate water channels and ponds in between their runways for fire fighting and landscaping purposes. If given good enough habitat they could even nests during the spring and early summer months.

Another key feature birds look for is the possibility of shelters. This article illustrates that shelter provides adequate opportunities for wildlife and birds to rest in, roost, and as stated previously, nesting. Smaller perching bird species such as Starlings and Blackbirds use tall grasses and reeds to roost in and feed. Practically any area that does not have human activity is suitable habitat for roosting. Seagulls, especially along coastal areas like open runways to sit on, particularly during storms that don’t allow them to sit in the sea. Seagulls enjoy sitting on the runways as it presents a safe environment where high visibility of their surroundings is possibly.

A good characteristic to look at that’s also illustrated is the local movements and national migrations of bird species that are come to the area. Waterfowl, gulls, and shorebirds consist of a great number of the migration species in North America. During a few weeks through the spring and fall while peak migration happens in a certain area, the highest number of birds will occur around the airport area. Daily and seasonal observations of bird activity need to be studied for lengthy periods of time to fully understand the main bird species that occur in an area and their movement habits.
Results and Summary

This article expresses many great characteristics and environments to look for in an area to understand what bird species will be predominant for the airport. While there may be many thousands of different species in an area, only a few certain species may utilize an airport for a certain reason. Food sources are a particularly important aspect to understand around and area and is arguably the most important drawing effect for bird species to a certain area. If there is no food present then birds will most like be in an area for a short time before moving on. Large amounts of food present will give birds many reasons to stay during the day, and move back to the area after roosting early in the morning until the evening. Water is also a particularly an important aspect. Large water bodies that sit for long periods of time can attract high number of bird species, especially waterfowl. In large bodies of water that are adjacent to airports such as rivers and lakes can attract larger species like eagles that prey on aquatic species. Correct and proper management of water pools and stormwater ponds can keep water levels low and keep vegetation and aquatic species from growing that attract and feed certain species.

The concept of wildlife control and an airport, in itself, is almost a form of art. I like to think of it as almost like a dance, where providing the correct steps and movements can influence your partner to follow. If done incorrectly, then the persuasion and emulation can fail. By presenting the correct habitats and food sources in different area away from the airport, drawing forces can be used to persuade local movements and even possibly, migration patterns over years. Persuasion can be very difficult. Many key factors come into effect to master the art of persuasion. Stated later in the article, the mentioning of lethal tactics and harassment can be used but only if the airports have obtained the correct form of permit for a certain species. Without this permit lethal tactics are not legally allowed to be taken even as a safety measure.
Project Justification

As an avid outdoorsman, I have always found to appreciate and push forward for conservation efforts and the education on how important it is to maintain our wildlife and resources. The conservation and safety of Bald Eagles and birds plus creating safer airports is a problem I would like to address and get the public involved in. I believe that for the problems that have been arising with wildlife strikes between airplanes and birds, a better understanding and thought could be implemented for the layouts and locations we chose for our airports. Air traffic is increasing to an all-time high and keeps increasing with populations rising. With more air traffic, higher chances of wildlife strikes occur and safety of passengers, pilots and wildlife must be considered.

This thesis could begin to help students understand and research on the connection between wildlife and air traffic and how designs could help increase the safety or our citizens and wildlife. Students and architects could learn to consider design strategies that focus on numerous problems of all types of life. The importance of this project and ideology for future designs can better the safety of people and wildlife as well as help save money in an economic standpoint. Economically the decrease in collisions between airplanes and wildlife would help decrease maintenance costs, safety issues, and reduce the risks of lawsuits for companies and personnel based on safety of passengers and pilots. The need for materials that are used to deter birds away could be reduced and save airports money and resources. I believe that a challenging project can push forward my academic thinking and problem solving while attempting to increase the thought process of our airport layouts. By pushing academic thinking in this subject, we can relay better ideas around the field of landscape architecture and architecture with the integration of wildlife thinking into our airport designs and surroundings of these sites.

To maintain the funding of this project it would have to be presented in the terms of safety for humans and Bald eagles. Safety is the biggest concern. By stressing how safety would increase for passengers, employees and wildlife alike the funding for the project would be beneficial to the airport and the city of St. Paul. Also, conservation and the preservation of our native resources would be important and help the landscape in the city. The funds would be from conservation program donations, donations from the public, the St. Paul Airport and from the City of St. Paul. Since it is a government facility and used by the public, government donations and grants would be asked to help increase the landscape for the city.
Project Justification

By being right next to the St. Paul airport along the Mississippi River it’s a perfect location for Bald Eagles and this problem happening today. Existing parks that can be redesigned in the site location give a great opportunity to incorporate humans and wildlife activity. The amount of landscape characteristics that surround the airfield gives a good chance to understand and test different types of redesign to decrease wildlife strikes. Changing the wetland and pushing the management of water levels, industrial zone redesign, and park redesign show many possible ways to airports and the areas around them.
Holman field, the alternative name for the St. Paul Downtown Airport, was named after Charles Willis “Speed” Holman. Charles Holman was born on December 27th, 1898 in the township of Bloomington in Minnesota. Holman, known as a daredevil, dropped out of high school and became a stunt motorcycle rider. Around the year 1917, he gained a reputation in the aerial industry starting from parachute jumping from planes. In 1922, Holman joined to be part of the flying exhibitions and used his crazy nature to thrill the public with their maneuvers and dives. His reputation was well known across the Midwest and this earned him the nickname “Speed”.

Holman entered into many races and fared very well. In 1926 he was employed by Northwest Airlines to fly mail from the Twin Cities to Chicago and neighboring areas in the Midwest. Eventually, we was promoted to operations manager of Northwest Airlines. In 1927 he entered into the air derby in New York and won the race from New York to Spokane, Washington in his plane the National Eagle. Incredibly, a stunt pilot broke Holman’s record for the most aerial loops in a consecutive order which was 1,093 and a world record. Holman flew over the city of St. Paul ready to take his record back, and beat the previous while setting a new world record of 1,433 consecutive loops. This new record would stand for a time of 22 years. Holman continued to place himself in many more air shows and increased his fame across the region. Sadly, on May 17th in 1931, while participating in a show over Omaha, Nebraska Holman’s plane crashed taking his life. Holman’s legend was lived on by being the first man inducted into the Minnesota Aviation Hall of Fame. Due to his amazing record and legend, the St. Paul Downtown Airport named their airfield after him in his honor. A possibly memorial to Holman could provide a historical and educational aspect to the park design.

Figure 9: Charles Holman
Historical Context

Holman field is lined along the Mississippi River and is designated as a “reliever airport” for the city of St. Paul. The airport is now operated by the Metropolitan Airport Commission and is established for private jets, small aircraft, a pilot training school and a National Guard Aviations unit is stationed there. The St. Paul Downtown airport was established in April of 1940 and utilized for WWII. Northwest Airlines operated the airport to house their B-24 Liberator bombers. The company employed over 5,000 people to work for the company during 1940 to maintain operations for the need of planes due to the war. By establishing an airbase in Minnesota, safety and security was increased from enemy bombings that could attack the coast. This theory was seen on December 7th, 1941 at the attacking of Pearl Harbor. Some B-24 Bombers that were housed at the St. Paul airport were equipped with an hx2 radar that was incredibly valuable for bombing runs in Europe.

The Holman Field Administration Building on the grounds was built in 1939 by the airport workers and employees from the WPA. The administration building serves as the main building of control for the airport and was designed by the architect Clarence Wigington. Clarence Wigington was the first African-American municipal architect in the country. Wigington also designed over 90 buildings throughout the St. Paul area. This site has been fortunate enough to be granted with a few interesting stories. The airfield was set as a backdrop in the movie called “Slaughterhouse-Five” made in 1972. Alvis Karpis, who was captured in New Orleans on May 1st, 1936 was flown into the St. Paul Downtown Airport while being accompanied by the F.B.I. director of the time, J. Edgar Hoover. Alvin Karpis was part of the Barker-Karpis gang during the depression era.

St. Paul Downtown Airport has a similar characteristic compared to O’Hare airport in Chicago in the fact that they are both placed near large bodies of water. While O’Hare is not placed along the Lake Michigan shore, bird species that inhabit around the lake have been seen on the airport grounds. Holman Field has a rich and unique history that the city of St. Paul should be proud of. After the war the airport was utilized throughout years and is still being used today. A new restaurant is being issued in the airport and new developments are still to come in the future.
The St. Paul Downtown Airport has a rich surrounding area. To the North and the East the airport is surrounded by the Mississippi River. Large amounts of barge traffic and summer boating traffic takes place around the airport. To the Southeast corner of the airport the Gulf of Minneapolis cuts into the landscape to provide portage access to the garbage and recycling center. This port also provides inland access for barges to drop cargo. By providing park space and water access for the public, social gathering spaces can help increase community involvement. Also, education purposes can help get citizens involved in community organizations and volunteering to rebuild our natural habitat across the state and country.

Across the river to the North and the East sits Municipal Forest and Battle Creek Regional Park. These areas of interest that will be redesigned provide many aspects to the community and give park space to the community of St. Paul. Open spaces and dense tree coverage allow for a nice outdoor park experience while integrating habitat for bald eagles to use. Along the North side of the site in interest, there are Native American burial mounds that are protected by law. The Indian Mounds Regional Park protects the culture of the Native American tribe that was once there.

Holman field resides directly to the East of highway 52, a bustling highway that connects people of Southern Minnesota to the Twin Cities. Directly to the Northeast of the airport, across the Mississippi River Highway 52 meets and joins into I-94 and 35E. Also, the airport sits near CHS Field that is home to the St. Paul Saints minor league baseball team. Baseball and adequate park space are just a few minor important things to the community of St. Paul. When it comes to the airport itself, not many people have ever used it. The majority of their air traffic is for private planes, business jets, and National Guard personnel. Many sports teams that come to play in Minnesota also fly into the St. Paul Downtown Airport.
Holman field in itself is a 576 acre site that sits above sea level at 705 feet. Bordering the Mississippi River the airport has been known to flood in the past and is susceptible to high water levels again. Although, the airport has been counteracting by implementing a flood wall in 2008 along the shoreline to hold water back from entering the field. Flooding has occurred in the past and runways were shutdown for a safety concerns. If flooded, water pockets have been known to sit on the runway for longer periods of time due to the airports flat structure. Holman Field has about a 10 foot difference between its highest and lowest point on the property.

Holman Field can be broken down into about three different categories. Vegetative spaces, Runways, and Structural and other hardscape grounds. The hardscape grounds are separate from the runways as they serve a different purpose for the airport and have less wildlife collision issues due to slow moving traffic. Of the 576 acres site, about 267 of these acres are made up from the vegetative spaces which consist of about 46.4% of the total area. In these spaces natural vegetation could provide good habitat or food sources for certain wildlife species. These areas also provide a permeable place to catch stormwater runoff for the site. Continuing, about 58 acres of the total airfield is made up of the runways. This makes up 10% of the total airport. These runways have a maximum concrete weight limit of 100,000 pounds and aircraft must weigh under this limitation in order to use the airport. The structural and hardscape grounds account for 251 total acres of the area which makes up 43.6%.

Structural and hardscape grounds are made up of the small roadways on the airfield that are used for safety and transportation purposes around the area. In the case of an emergency such as a fire or a wildlife strike, smaller roads must be issued along the runways to allow access for firetrucks and other safety personnel vehicles. Also, the areas that are made of buildings and other structural components consist mainly along the edges of the airfield to keep the middle and the majority of the field open for high visibility of the airspace and provide adequate room for airplanes.
Physical Context

The Surrounding area of Holman Field in itself consist of many different typological landscapes for the area. The Mississippi River sits about 12 feet lower then the airfield. To the southern portion of the airfield, there is a wetland that is filled year round in between a garbage and recycling center and the airport. This is a recipe for disaster as it promotes many reasons for birds to be attracted to the area. Vegetation and possible aquatic species reside in this wetland and good management practices should be taken to reduce bird numbers around the airport. These types of wetlands are generally too small for Bald Eagles to be focused on the area, especially when adjacent to the Mississippi but reducing other bird species populations around the area will also be beneficial as Bald Eagles to not make up all of the occurring wildlife strikes.

As stated before, directly next to the wetland is a recycling service that’s open to the public to bring metal recycling. These areas may not be full of food but these centers can still attract bird species around the area. This center is connected to the Gulf of Minneapolis port for barges to drop off and pickup recycling in the area. These barges when waiting tie off to the North and East side of the airfield in the Mississippi and these attract birds such as seagulls and crows. This is dangerous as it has been noted from my mother, an air traffic controller for the St. Paul Downtown Airport, that flocks of birds have been seen hovering along the ends of runways over the barges causing possible issues to arise.

Municipal Forest and Battle Creek Regional Park that reside across the river and are split by Warner Road and bordered by highway 61 on the East side. A large body of water resides in the middle of Battle Creek Regional Park. Pigs Eye Lake also sets on the south side of the park and is a backwater of the Mississippi River. These water bodies are large enough to attract the attention of Bald Eagles for hunting purposes. During the winter Pigs Eye Lake will be frozen over so Bald Eagles will usually soar over these water bodies during spring, summer and fall until the water freezes over. Although, the Mississippi River generally stays open during the winter in certain spots which allows Bald Eagles to hunt on a yearly basis.
Physical Context

Directly across the river to the East from Holman Field, an industrial zone splits Battle Creek Regional Park from the river. This industrial zone is about 280 acres in size. There are many sites that use this area. There’s a metro plant, dock terminals for shipping, aggregate industry, wood recycling center and three railway yards. These industrial zones are generally issued to be built away from airports as their attractive personalities to birds. This industrial zone is built directly across the river and all three of the runways on the airport are pointed directly at the zone. Moving the industrial zone away from the airspace would be more beneficial to the airport, but that would be very unlikely and an expensive tactic for all the companies involved.

The St. Paul Downtown Airport is the lowest area from the surrounding neighborhood. Although, all the water drainage on and around the site eventually leads back to the Mississippi River, which in turn raises water levels and increases flood chances. To the North and West side of the airport, the city of St. Paul can be scene in the skyline. Heavy populations of the city reside on these sides of the airport and account for the majority of the foot and car traffic in the area. Many businesses small and large set up in these areas, along with residential housing. Their connection to Municipal Forest and Battle Creek Regional Park are needed for public green space and a getaway from the city.

In a nutshell, the land typologies and physical context around the site is a mixture of many different types. There’s a spectrum on natural landscapes and green parks to industrial zones and recycling centers. On the West side of the site zone there’s city, on the east is woodlands and open green spaces with the airport residing right in between the two. Integrating these typologies together could be beneficial to the city, the airport, and for the health and lifestyle of Bald Eagles.
Site Analysis
Breaking down the project site into 4 main areas illustrates where different designs must be implemented to fulfill the different requirements needed to make these areas successful.

1. Suitable Habitat
This area is where the focus of Bald Eagle habitat and park space will be provided.

2. Industrial Zone
This section may require rehabilitation and phytoremediation practices. This area is where higher human traffic areas will persist as the airport runways intersect directly to the area.

3. Airport
This area represents Holman Field and where certain parts of airport redesign will take place.

4. Wetlands
These wetlands will have to be managed and as they sit right in between the airport and a recycling center
Contours

This contour map illustrates where steep slope areas are in the site area. These steep areas are places to note and watch for high stormwater runoff and erosion problems. Flat lands around the site will need to be watched and possibly managed to reduce sitting water for long periods of time.
These symbols represent the major routes that are used to access the site area. Two major highways, I94 and highway 52 pass along the North and West side of the project area. Two smaller routes are used to access into the parks across the river, and to the only access point for the airport.

The runways on the airport are mapped out to illustrate and understand the direction that airplanes will be taking off and landing. We can see that planes will fly directly over the industrial zone and other site areas that will be part of the redesign.

Three railways run through the site and could possibly be integrated into the redesigns.

A flood wall along the North and East side of the airport was placed in 2008 to avoid floods that could occur annually.
The climate of the site provides an opportunity for winter and summer usage. Wind buffers placed along the West can help keep the proposed park space warmer during the winter. Leaving the winds to blow into the airport is important since airplanes take off and land into the wind. There are large amounts of sun during the summer and winter on the airfield and providing shade for pedestrians will be important.
This map illustrates the heavy amounts of tree coverage on the site. These areas are important to understand as heavy tree coverage is where Bald Eagles nest and perch for hunting and an overlook of the land.

Open fields and open water are where Bald Eagles will soar and hunt for their prey. Understanding where these open and flat fields are will issue a great understanding of where eagles will most likely be seen flying in the air and sitting eating their prey.
This confrontation zone illustrates where Bald Eagle flying patterns do not want to be seen. Providing more of a park system for the public may deter eagles away from these areas and force them to look elsewhere for hunting areas. The crossover with the airplane runways shows where there is a high chance of a collision to occur in the air.
There are quite a few ideas and conclusions that can be drawn from this analysis. To illustrate these maps to understand what’s at the site really helps to visualize what areas are of importance compared to others. There were six key maps I wanted to focus on that I felt were the most important to this thesis. As this project area is over 2,000 acres, it’s hard to understand many of the specifics of the future site. Although, the generalizations can be drawn and a higher detailed micro-analysis can be done when specific areas and components of the project are discovered. The six main categories that were looked at were the major design areas, major transportation routes, the tree coverage and potential hunting grounds, site contours, climate, and confrontation zones.

The map of the major design areas is issued to understand where the important sections of the site are broken down. The suitable habitat is important to draw as its representative of where good habitat for Bald Eagles is and that this area is where it is expected to see nesting and high perching numbers of the birds. The industrial zone is an important part to this site. A question to answer will be if keeping some of the industrial businesses or components will be beneficial to the site, or if their importance is too great to the city of St. Paul to be drawn away and forced to move from the site. Contaminated ground could be present here and remedial tactics would be important to issue to give back and clean the landscape. The wetlands are important to understand and realize they exist. Wetlands attract many different types of bird species and a management plan should be implemented to the airport grounds to maintain water levels to a certain depth and ensure proper drainage is occurring. Finally, the airport is mapped to express it’s location and size to the rest of the site. The airport will need to have it’s own design characteristics implemented to deter Bald Eagles away by from the grounds and to keep them from sitting and feeding on runways where the majority of the wildlife strikes occur.

A contour map is applied to the analysis as a proper way to study water drainage and high potential erosion areas. Erosion and drainage into the Mississippi River can cause many potential problems for the parks, airport, and anything down river from the site. Erosion control tactics should be taken into account during the design phase. Locations where water can pool should also be considered as it risks vegetative and aquatic species to develop and increase bird populations on the site.
Major transportation routes are mapped to bring awareness of high traffic possibilities and where the majority of the traffic will be coming from to get to the site. Interstate 94 and highway 52 bring the majority of the traffic from the rural areas surrounding the Twin Cities. These two highways are where the majority of the public will come into to get to the site. A couple smaller roads are illustrated to show where traffic currently moves in the site area. These roads also split the landscape into certain sections and areas so pedestrian crossing will need to be issued in the design. Railroads are mapped to understand where shipping runs to the industrial site on the project area. These trains can be hazardous to wildlife and pedestrian traffic even if they are only allowed to travel very slow speeds. Careful consideration will be taken on how to deal with these rail tracks.

Climate is important to understand so that it can be determined if the site will be used year round or only during certain months of the year. Wind buffers may need to be implemented to block wind for pedestrians using the public park spaces. Also, there is a large temperature fluctuation at the site area. Ice will develop during the winter months, and shade will be required during the hot summer months. Water access should also be implemented for summer use and possibly winter use in certain areas.

The tree coverage was mapped on in the analysis to better understand where heavy tree canopy can be found. These trees are perfect for Bald Eagle habitat and can be utilized in the design to control their movements, resting, hunting, and nesting locations. This map connects with the confrontation zone analysis to better understand where airplanes taking off and landing will be flying around the airport. The crossover paths of the two create a hazardous area where there is a high chance for strikes in the air to happen.
Performance Measure:

In my thesis project for the safety of Bald Eagles and airplanes at the St. Paul Downtown Airport the main component that would have to be measured is if there in fact was a reduction in the amount of strikes between airplanes and Bald Eagles at the site. While this is the overall goal for the project, a few smaller goals are implemented as well. These consist of creating a public park space, providing education to the site users, integrating habitat and hunting land for eagles into the area, and creating waterfront accessibility to the public. The success of these areas will be determined by the amount of park visitors per year, and if the population of Bald Eagles in the area remain healthy and at a steady rate while reducing collisions with airplanes. Estimations of bird populations seen from the airport grounds could be measured around the site area to see if healthy populations of all bird species from the region are still using the area around the site. Comparing these populations to the total number of birds actually seen on the airport grounds could be used to determine if the airport redesign is dissuading Bald Eagles and other birds to land elsewhere.

Performance Measure Source:

These performance measures would have to be obtained over a longer period of time to accurately measure if the new design is working the way it’s intended. Many sources would need to be accounted for to measure these variables on a daily or monthly basis. Examples include the St. Paul Parks Department to measure the amount of site users per year. Also, I believe the DNR would be a great asset and partner in this thesis to keep track and record Bald Eagle populations in the area. Finally, the St. Paul Airport would keep track of the amount of wildlife strikes that have occurred each year, but this is already done as it is required by law. By utilizing and working with these organizations accurate numbers can be measured on a certain schedule. Once these numbers have been obtained for a few years (as a minimum) then adjustments could be made for future designs to the area.

Performance Analysis:

As said previously, to correctly understand the effectiveness of the site this analysis process would have to be taken for a set number of years. Although, we can see Environmental Performances measured in the first year. We can measure if there is a healthy amount of native plant species and if they are providing adequate habitat for wildlife in the region.
Performance Criteria

Also, perhaps a test or simulation could be implemented in the amount of average rain water that would be filtered before running into the Mississippi River from the site. Contaminated ground could be checked and measured if it’s being cleaned from the current industrial and recycling sites on the project area. Drawings will be used to express the theoretical ideas behind this thesis and if my project could be measured well.

The Environmental Impact of this thesis is a major component behind its purpose. Creating a public park space that synthesizes conservation with city could lead to a greater integration between man and nature. Populations of Bald Eagles may return and remain at a healthy level in the area. Resources needed for airplane repairs could be reduced if wildlife strikes are decreased. Re-inhabiting the site with natural vegetation could lead to cleaner water runoff into the river and phytoremediation techniques on the site grounds.

Correct space allocation is important to bring a balance of space for the public, but while creating enough habitat for Bald Eagle hunting and nesting grounds. Creating a nature walk for city users but controlling their movements through raised walkways would help benefit people for their physical and psychological health. These walkways will also provide behavioral control to keep the public from disturbing too much of the natural habitat for the Eagles.

Performance Judgment:

In all honesty, in my personal opinion if an average of one wildlife strike per year is decreased, then it’s a successful project. The reason I feel this way is because a lot of problems can arise from just one wildlife strike. If by chance the one wildlife strike that was prevented ended up saving the lives of 3 passengers, I would deem this as successful. That being said, preventing more than just one wildlife strike a year is a much higher goal. Deeming this project as a complete success would require the performance analysis to measure a complete number of ZERO wildlife strikes have occurred at the St. Paul Airport after the design has been implemented. Until this number is met, and is met on an annual basis, then there will always be room for adjustments and new designs to be implemented until this goal is met. Populations of bird species that sit on the airport grounds should have decreased as well.
Since the beginning of this journey throughout thesis, I feel that I have obtained much more knowledge about the subject than I thought I was going to. Stated earlier, I’ve learned about this problem through my mother. Hearing the stories of what becomes of Bald Eagles when these collisions happen is enough to sadden anyone to the heart. I have learned a lot about the subject from my mothers first hand experience at the airport. From what she states, the majority of the strikes she’s seen from the airport tower happen on the ground. Watching the plane travel across the runway to gain speed and hoping that the bird will move. Most of the time, it doesn’t. The new technology behind our aircraft and their travel speeds today are too much for the majority of birds to handle. Perhaps new regulations could be placed that require air traffic controllers to communicate with planes to slow their speeds to give a higher chance for birds to scatter in time. A couple of personal interviews will be issued throughout the remainder of this project with airport personnel to gain more knowledge of the subject from those who have experienced it firsthand.
Sources


Previous Studio Experience

2nd Year
Fall: Kathleen Pepple
Tea House <> Fargo, North Dakota
   To understand the deeper meaning behind design
Cooper Community Garden <> Fargo, North Dakota
   Spacial recognition and relationships with client suggestions

Spring: Dominic Fischer
Agincourt <> Imaginary Location
   Historical and story designing
Mickelson Park <> Fargo, North Dakota
   Open space park design

3rd Year
Fall: Young Jae Kim
Library Park <> West Fargo, North Dakota
   Theme based design around a central topic
Civic Center Redesign <> Fargo, North Dakota
   Collaboration in high density area

Spring: Kathleen Pepple
Agency Village <> Agency Village, South Dakota
   Heritage design and large group collaboration
Chicago Neighborhood <> Chicago, Illinois
   Neighborhood and small area design
Friluftsliv <> North Dakota
   Permacultural and agricultural design practices

4th Year
Fall: Jay Kost
Mission Bay <> San Francisco, California
   Designing large scale in high density areas
Schmidt Brewery Model <> St. Paul, MN
   Metaphorical model building based off essence and forms

Spring: Matthew Chambers
Mid America Steel <> Fargo, North Dakota
   Phytoremediation and rehabilitation landscape design
North Country Point <> Warroad, Minnesota
   Small community development and historical preservation
Joseph Michael Potzmann
18684 Patrick Ave.
Hastings MN, 55033

Personal Contact:
Phone: (612)-325-8750
Email: jpotzmann@yahoo.com

Never stop learning.
While your character may fade from memory,
your legacy and reasoning can live on throughout history.