

Senior Capstone Booklet

The Lewes Birding and Biking Center

By: Jack Daly Advisors: Denise Husband RLA, Rodney Robinson RLA, Mark Prouty PE



Project Introduction

My project is focused on the Howard H. Seymour Water Reclamation Plant located in Lewes, Delaware. For this project the wastewater treatment plant (WTP) will be shut down and a new wastewater treatment plant will be built and functioning the town of Lewes in an area unaffected by sea level rise. The Howard H. Seymour Water Reclamation Plant will be affected by sea level rise and the residential housing behind the plant will be destroyed. By reinforcing a raised train rail line on the site, a bermed trail can be implemented to protect the site from sea level rise. The purpose of this project is to protect the current infrastructure that will be underwater if nothing is done.

Currently, the site is a 50 acre tidal marshland that includes the Howard H. Seymour Water Reclamation Plant at the north western part of the site. The plant services over 3,000 residents and all of the wastewater from the town of Lewes is run through this plant. The marshland will be underwater with one foot of sea level rise, the plant will experience flooding with two feet of sea level rise. Due to the projected sea level rise on the site the WTP will become inoperable with salt water intrusion.

Tackling this problem would be advantageous for the town of Lewes. With the raised trail protecting the now defunct WTP, the plant will undergo an adaptive reuse being transformed into an area for bird rehabilitation, birding and biking. This site will promote active living in the community that has a beautiful natural environment. The site would be a direct connection between the beach and town center. With such a high number of people that visit Delaware's beaches every summer, the bermed trail system would be favored by families, commuters, joggers, bikers and those looking to enjoy nature.

Table of Contents

Mission Statement	4
Project Location	5
Town History	7
Site Analysis	8
Flooding and Sea Level Rise	18
Design Process	22
Final Design	32
Case Studies and Research	40
Works Cited	53
Conclusion	55

Mission Statement

Mission

My mission is to transform the defunct Lewes wastewater treatment plant (WTP) into an outdoor center for the people and visitors of Lewes Delaware to enjoy everyday. The Lewes Birding and Biking center will have an emphasis on bird rehabilitation and birding as well as connecting to the existing biking trail system that runs along the site. As of now, there are no bird rehabilitation centers in Sussex County, meaning that injured or orphaned birds in the area currently have to be transported to other locations for care. By working with Tri-State Bird Rescue and Research, injured birds will be able to rehabilitate closer to their natural habitat. The site will include new amenities benefiting the birding community, allowing people to view birds in their natural habitat. The transformed site will include a resting area for bikers and include all the necessary equipment needed for a biking facility. The site will also be designed to protect the center and surrounding houses from sea level rise.

Goals

Rehabilitation and Rescue

- A rehabilitation center on-site can provide care for injured or orphaned wildlife, with the goal of releasing them back into the wild.

Public Access and Recreation

- The wildlife center can offer increased public access to natural areas and recreational opportunities such as hiking, birdwatching, and wildlife viewing.

Environmental Sustainability

- Serve as a model for sustainable practices, a constructed wetland will clean the wastewater for the wildlife center.

Educational Components

- Educational programs and opportunities would be made available for the community to learn about the local wildlife and how to conserve and protect it.

Conservation and Protection

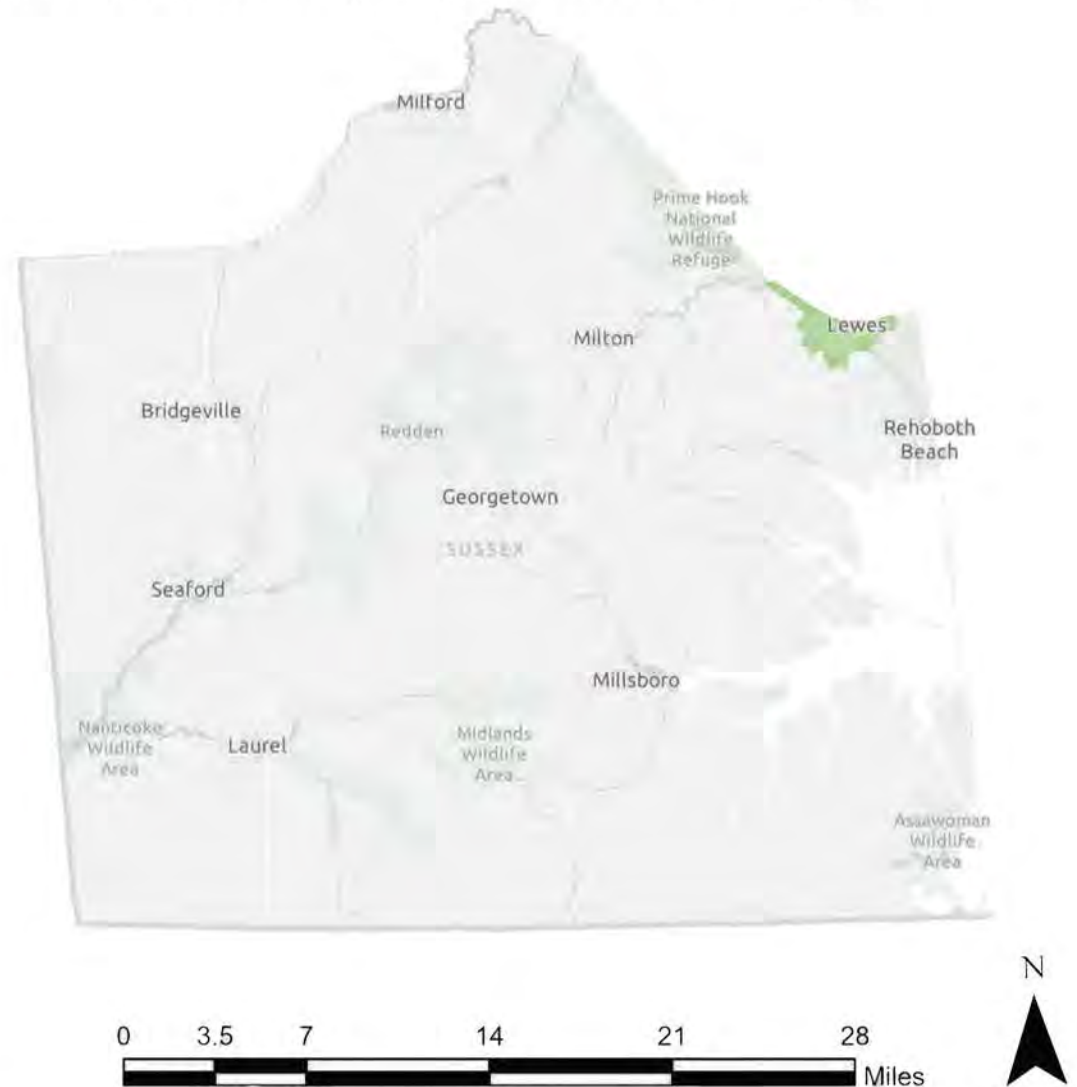
- Conserve the local wildlife populations and their habitats through research, monitoring, and restoration efforts.

Project Location

The Town of Lewes is located in Sussex County, Delaware. The state view of Delaware will highlight Tri-State Bird Rescue and Research (black) and site location (red).

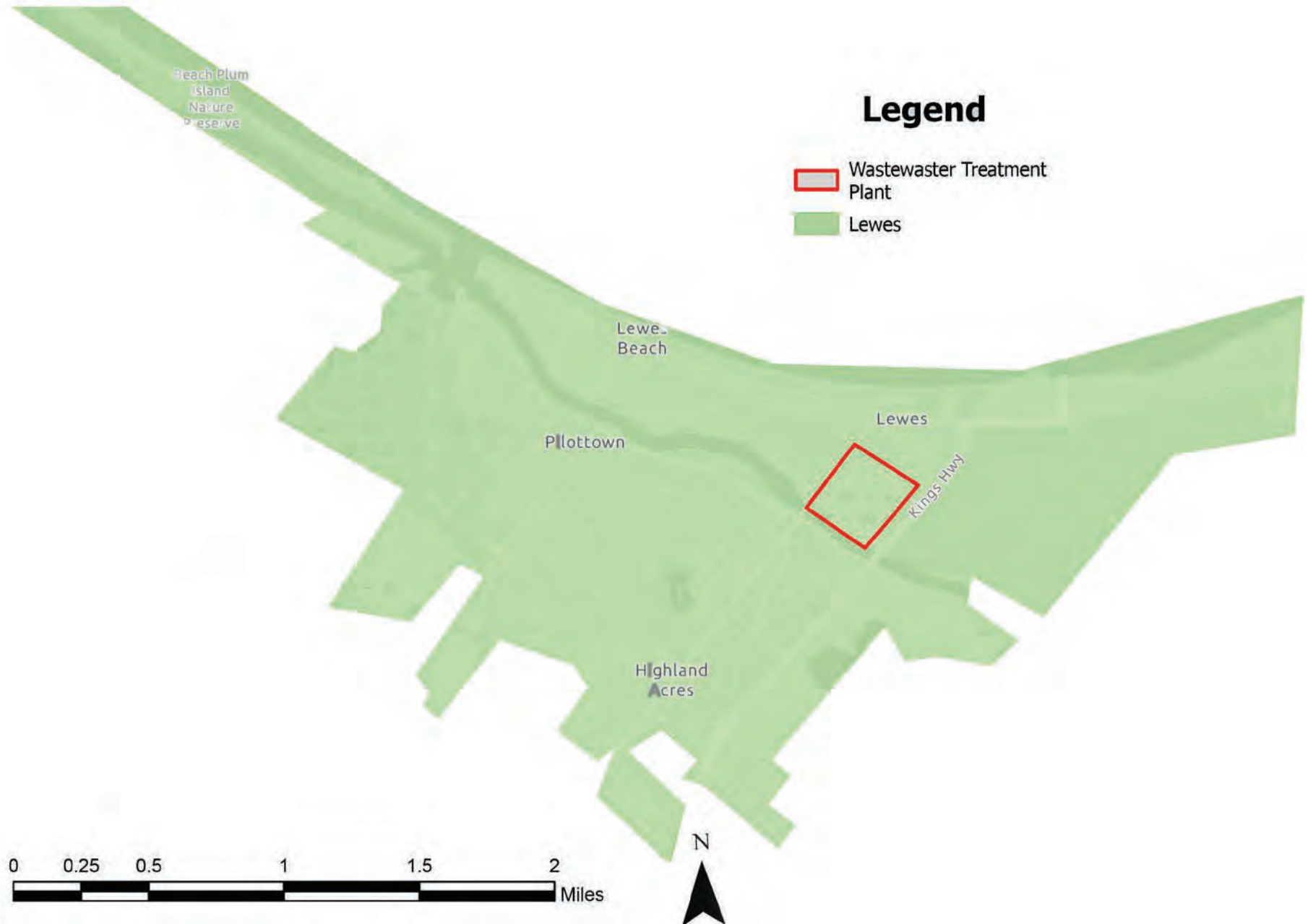


State view



Sussex County view

Project Location



Town History

Lewes is a historic town located in the state of Delaware, known for its rich history and proximity to some of the state's most stunning beaches and natural areas. It was founded in 1631 by the Dutch, making it one of the oldest towns in the United States.

The town is a popular destination for visitors during the summer months. The town's population swells during the summer months, with a vast number of tourists visiting the nearby beaches. Millions of people visit the Delaware beaches every year, 2021 saw a record high of over 10 million people visiting the beaches.

Just a short drive away from Lewes is the Cape Henlopen State Park, which offers visitors a range of outdoor activities to enjoy. The park's beaches are a popular spot for swimming, sunbathing, and fishing. Visitors can also explore the park's extensive trail system, which includes over 17 miles of scenic paths and offers breathtaking views of the park's stunning natural beauty. In addition, the park offers camping facilities, picnic areas, and a variety of educational programs for visitors of all ages.

The trail system in Cape Henlopen State Park is a major draw for locals and tourists alike, with many people using the paths for exercise and outdoor recreation. The park's trails provide an ideal location for hiking, biking, and birdwatching, and the park's natural beauty provides a peaceful and serene environment for those looking to escape the hustle and bustle of city life. The park's trails are well-maintained and offer a range of difficulty levels, making them accessible to people of all fitness levels. The park's trail system is an essential part of the community's active lifestyle, providing a safe and enjoyable environment for residents and visitors to enjoy the great outdoors.

Historic Drawbridge located on site



Site Analysis



Site Photos

These photos help you get an understanding of what the tidal marsh looks like on the site. Also included is the old train bridge that was manually turned and the existing bike path that runs along outer edge of the site.



Tidal Marsh



Tidal Marsh



Tidal Marsh



Tidal Marsh



Old Train Bridge



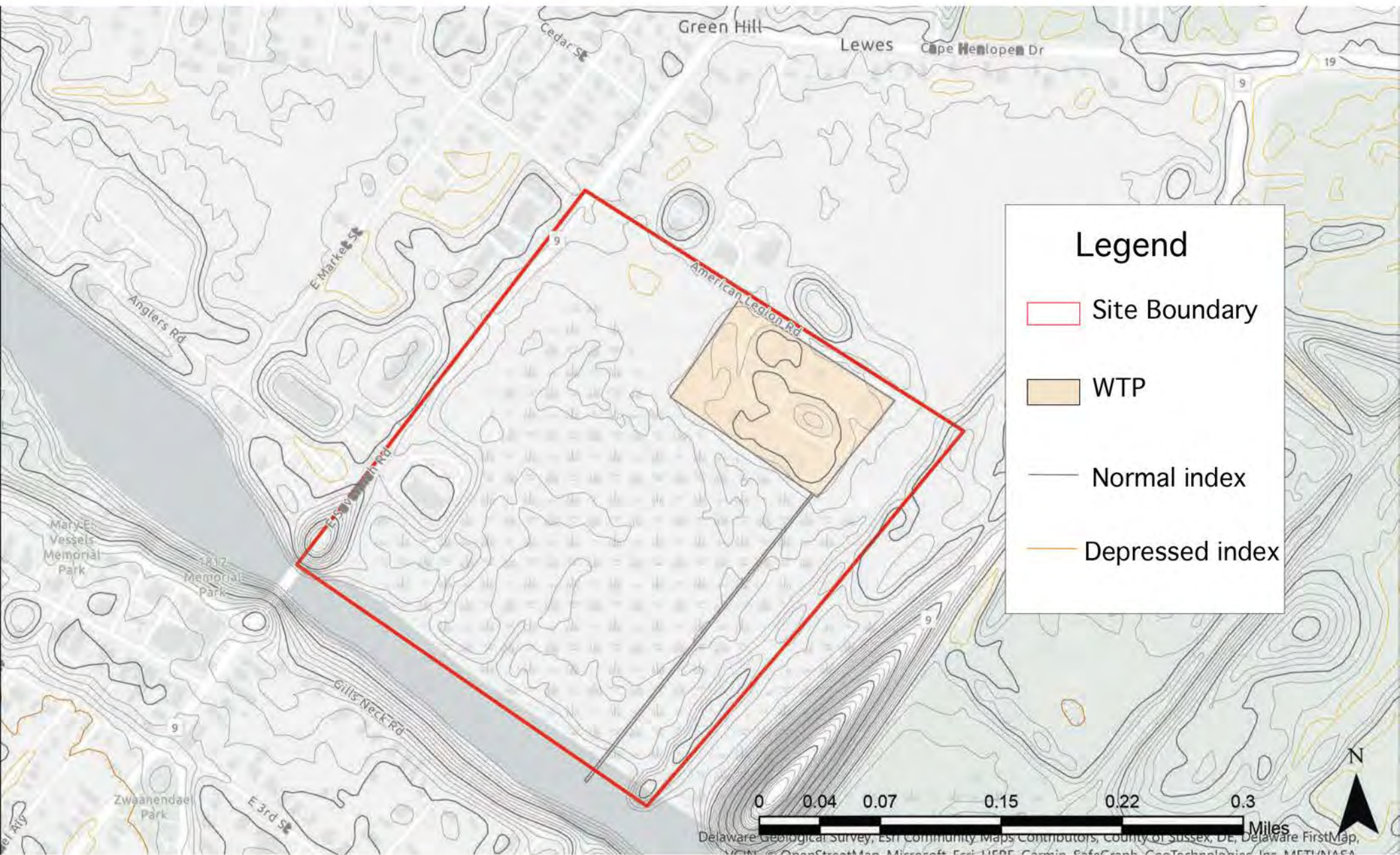
Bike Path

Howard H. Seymour Reclamation Plant



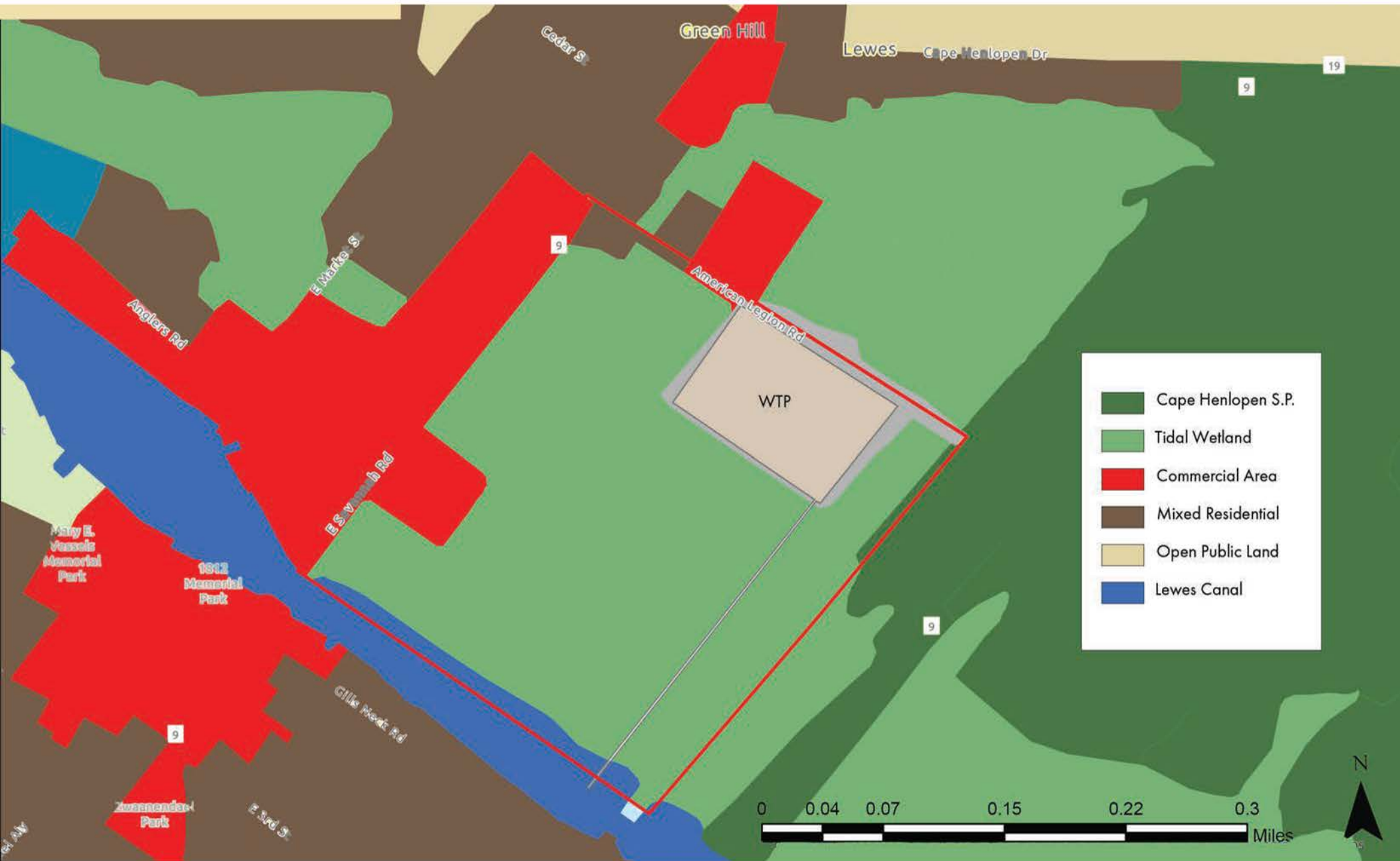
Contour Elevation

The contour elevation map shows off that there is very little change in elevation throughout the site and beyond. The majority of the site is in a low lying area.



Land Use

This land use map shows what the surrounding areas around the site are used for.



Protected Public Areas

This map highlights that the site is a protected natural area along with the land behind it. More the reason to protect and preserve it.



Natural Wetlands

This map shows how the site is connected through wetlands with other natural wetlands in the area. These wetlands will provide birds with a critical spot to find their next meal.



Trail Systems

The Junction and Breakwater trail runs right along the site and is a direct connection between the town center and Cape Henlopen State Park. There is a number of other trails that run along the site connecting to different amenities.



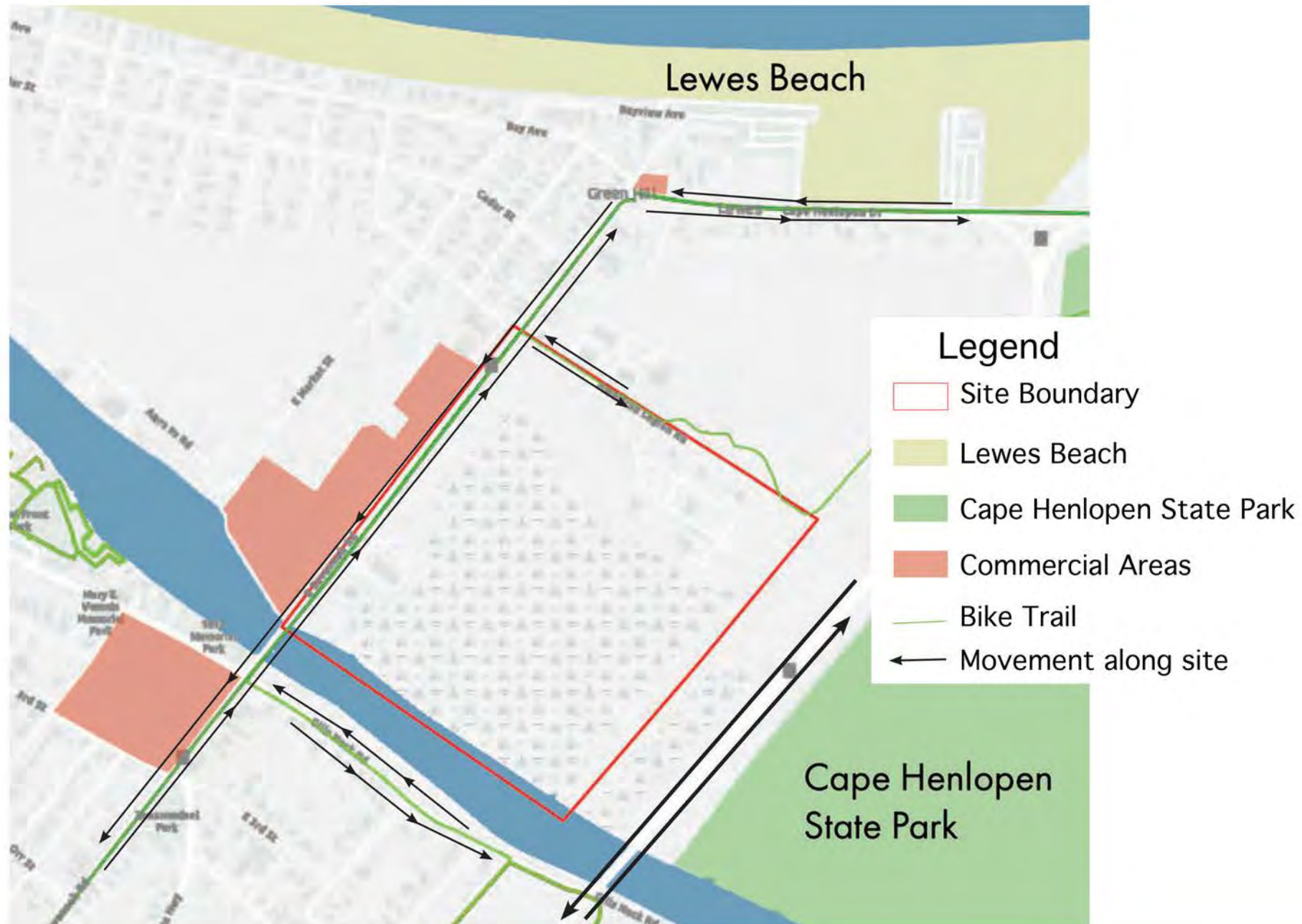
Historic District

The town of Lewes has a lot of history in it and with the old train bridge remaining on the site it will add another historic landmark to the town located directly on the site.



Context Diagram

The Junction and Breakwater trail runs right along the site and is a direct connection between the town center and Cape Henlopen State Park. There is a number of other trails that run along the site connecting to different amenities.



Flooding on the Site



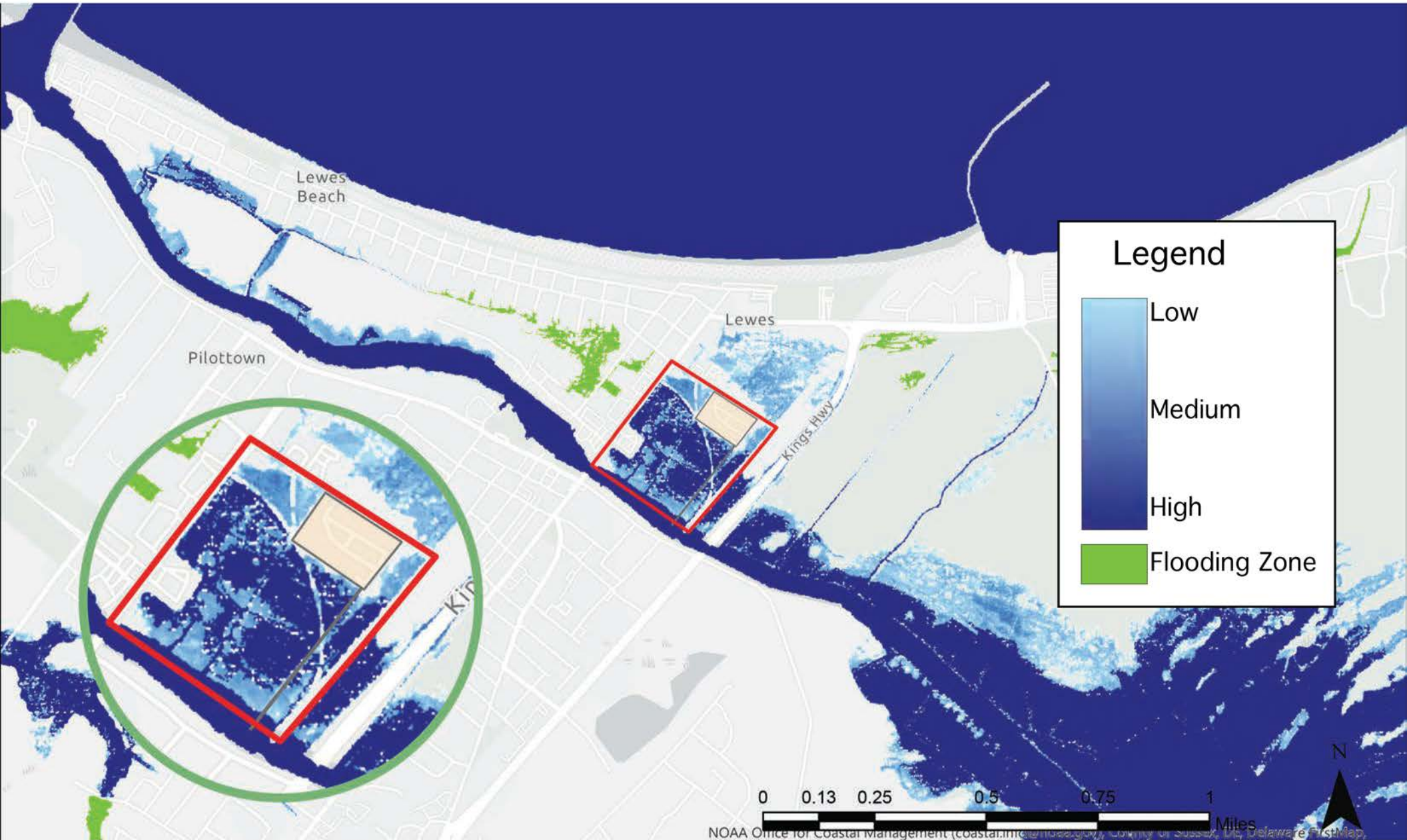
This aerial shows how flood water can very easily move throughout the site and affect the residential housing behind the site

You can hardly tell the difference between the Lewes canal and the marshland that makes up the site location. The flood water also spills into the roadway that runs along the site.



Sea Level Rise - 1'

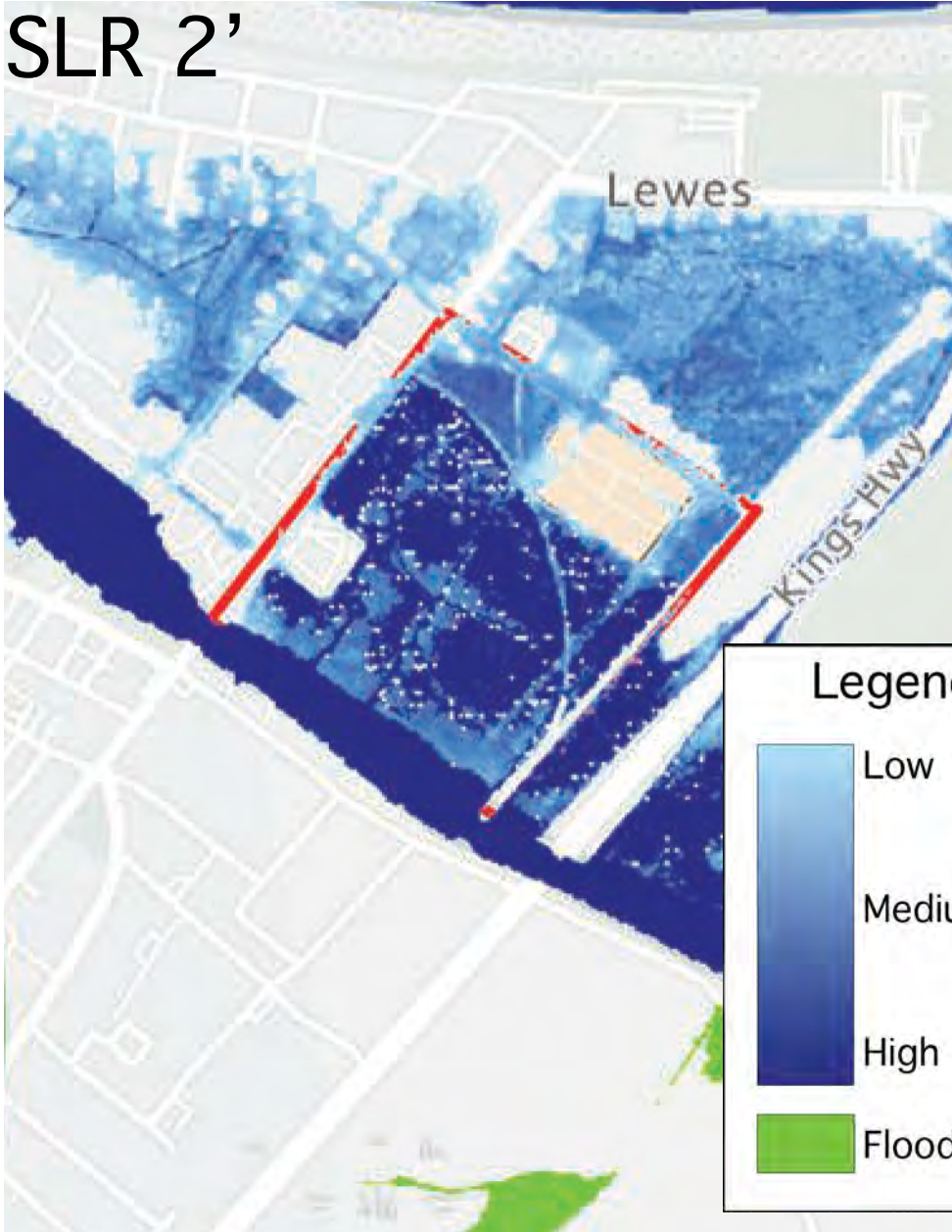
With 1' of sea level rise all of the marshland will be underwater along with areas behind the site.



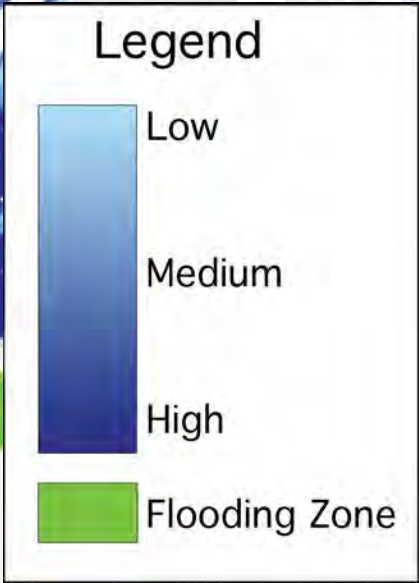
Sea Level Rise - 2' & 3'

Sea level rise continues to devastate the site location and housing behind the site.

SLR 2'

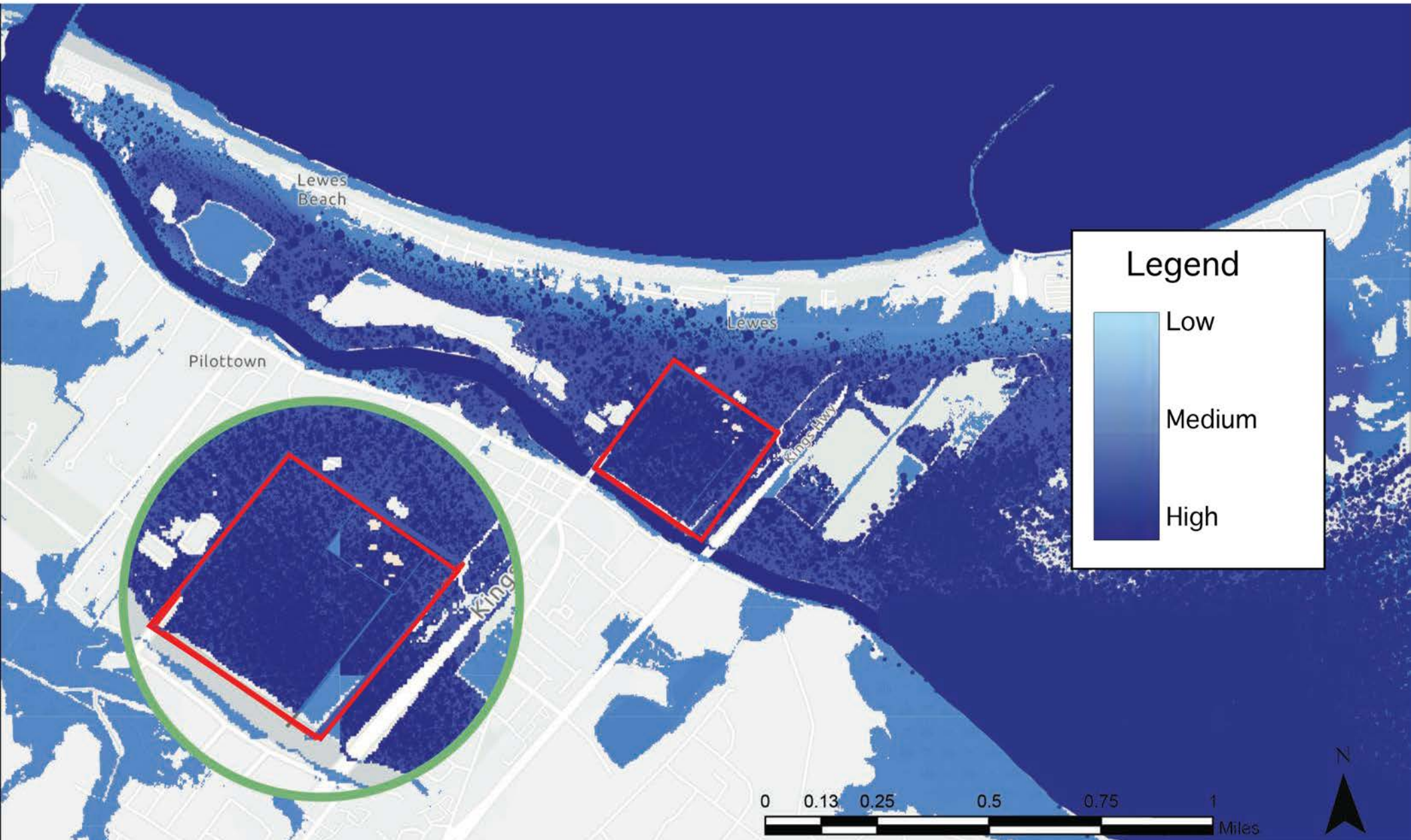


SLR 3'



Sea Level Rise - 7'

If nothing is changed to slow or mitigate the rise of climate change studies show that by 2100 the sea level could rise up to 7' this would completely sever the town of Lewes.

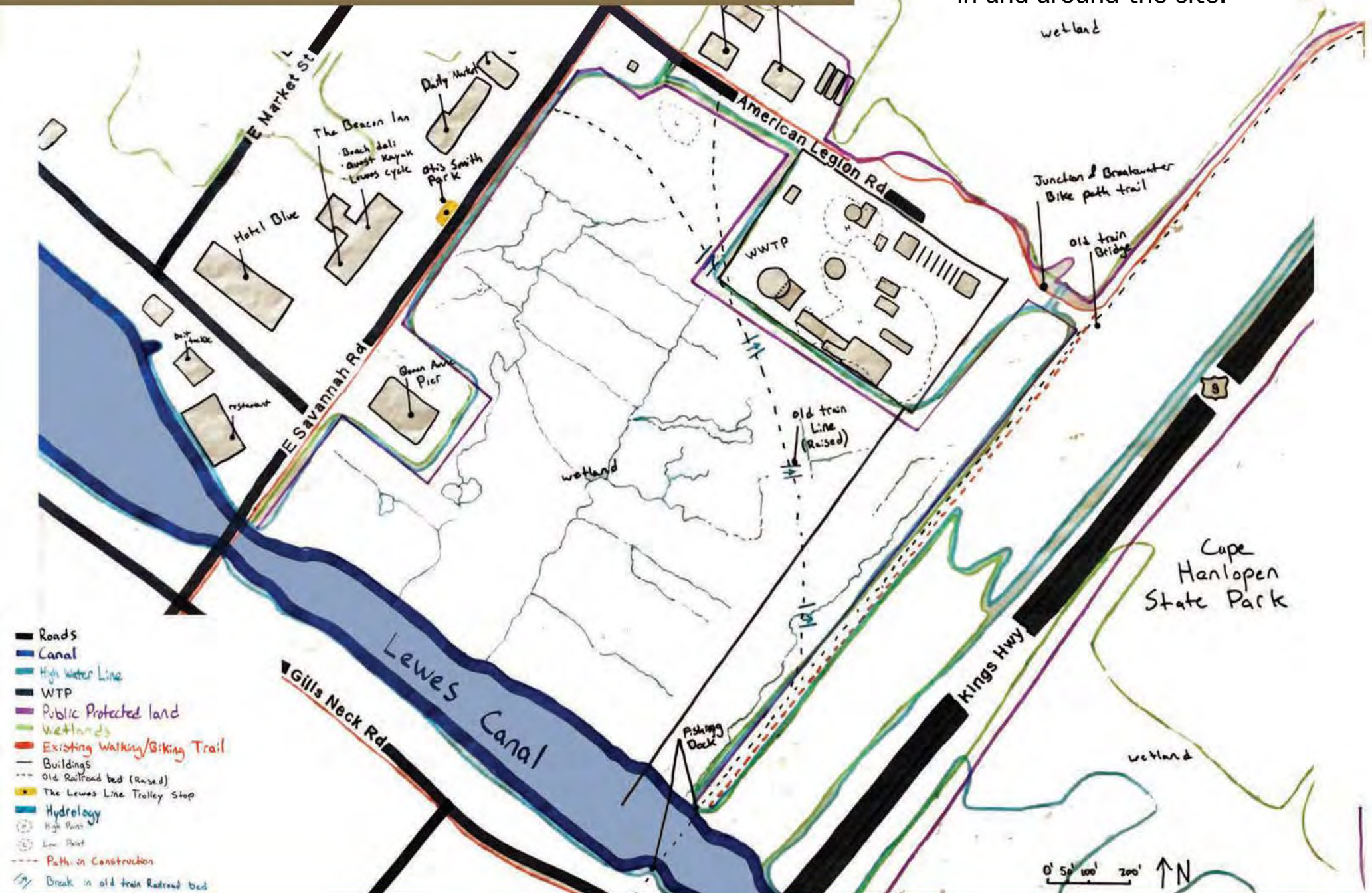


Design Process



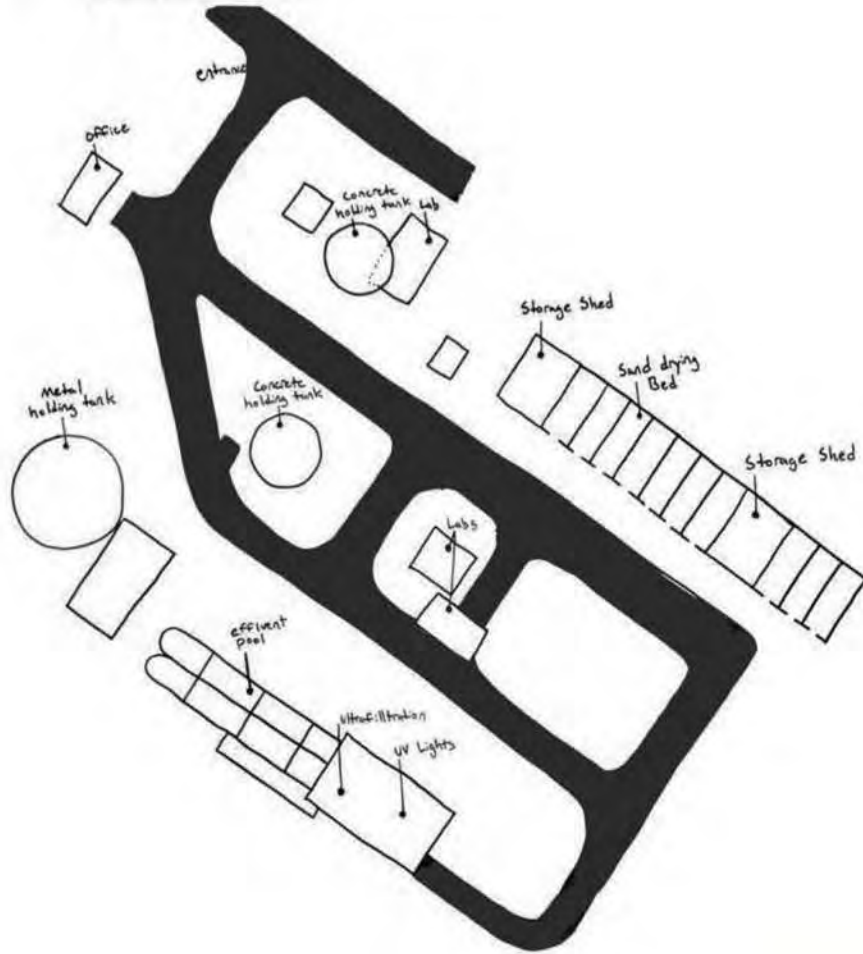
Opportunities and Constraints

This opportunities and constraints map gives you a more in depth understanding of what is happening in and around the site.

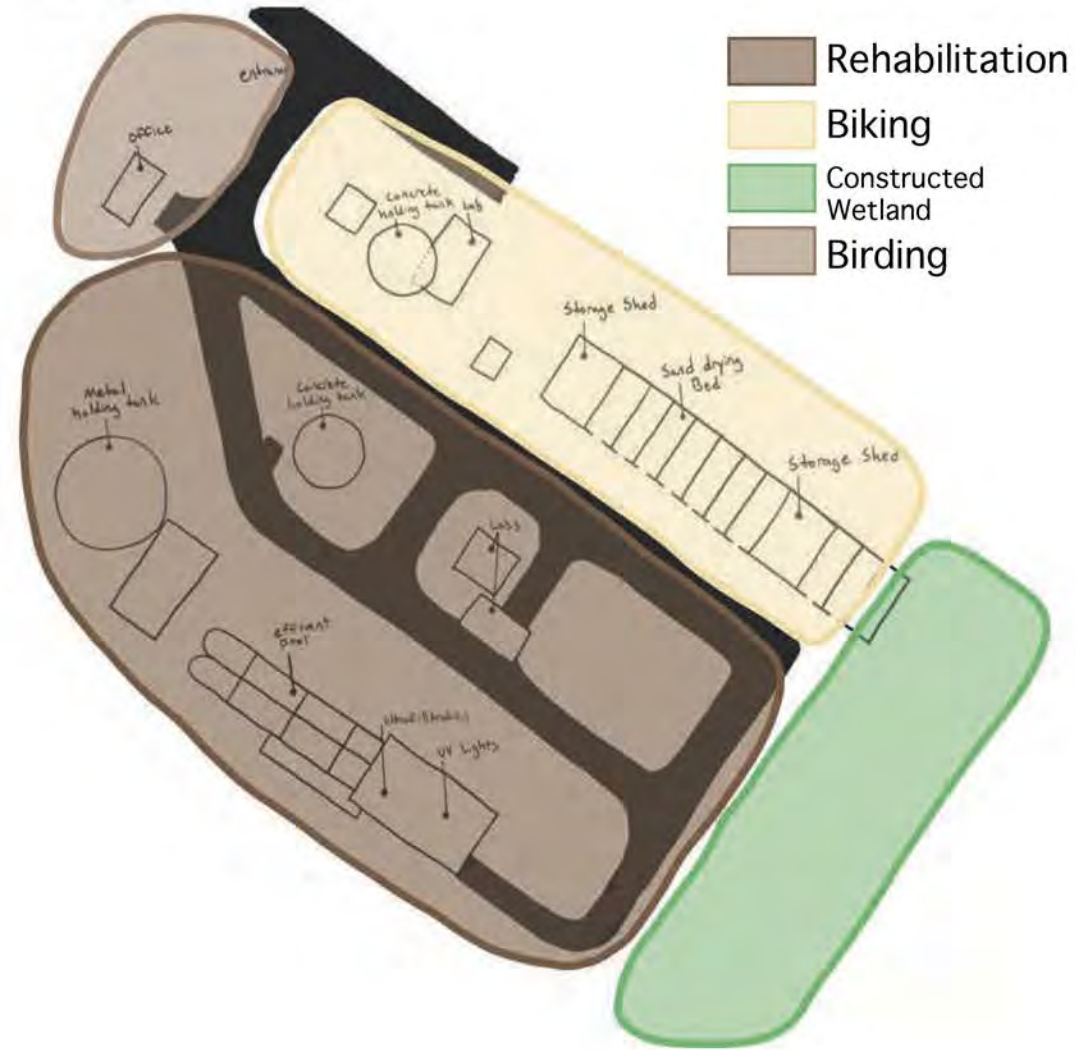


Adaptive Reuse

Current WTP



Adaptive Reuse



Current Bird Rehabilitation in Delaware



Tri-State Bird Rescue & Research is a nonprofit organization based in Newark, Delaware, that provides wildlife rehabilitation services to injured, sick, and orphaned birds. Tri-State was founded in 1976 and is recognized nationally for its birding expertise. The organization's mission is to "rescue, rehabilitate, and release injured, orphaned, and oiled wild birds while providing compassionate care to all animals entrusted to us." Tri-State operates a state-of-the-art wildlife rehabilitation center that is equipped to provide medical care, rehabilitation, and long-term housing for a wide range of bird species. Tri-State Bird Rescue and Research would be a parent facility to the Lewes Birding and Biking Center.

An Extension of Tri-State Bird Rescue

Tri-State Bird Rescue and Research is a state of the art, non profit facility dedicated to the rehabilitation and release of native birds in the tri state area and surrounding states. Tri-State is the only bird rehabilitation center on the east coast that is authorized to care for birds affected by oil spills. Due to this accreditation the Lewes Birding Center would be better Used as a satellite facility to compliment Tri-State Bird Rescue and Research.

Birds with minor injuries may rehabilitate at the Lewes Birding Center, while birds with major injuries will also be treated at the Lewes Birding Center before being safely transported to Tri-State Bird Rescue and Research for their rehabilitation.

Tri-State is a state of the art facility however they do lack the needs for waterfowl rehabilitation. This is where the Lewes Birding Center comes into play, by adaptively reusing the existing water tanks on the site I can create an artificial pond for waterfowl to rehabilitate. The Lewes Birding Center will have a focus on waterfowl rehabilitation but it will have flight cages that will cater to other categories of birds. Some examples would include raptors, songbirds, sea birds and other medium/small native birds.



Facility Needs

Skilled Staff and Volunteers

- Trained personnel including wildlife rehabilitates and volunteers who are able to handle and care for birds properly.

Veterinary Care

- Access to qualified bird veterinarians and necessary medical equipment to provide proper medical care, diagnostics and treatments for injured or sick birds.

Specialized Equipment

- Incubators, brooders, heat lamps, perches and feeding tools.

Aviaries and Enclosures

- Various sizes and shapes of flight cages for different types of birds that provide the appropriate space for birds to fly, swim or paddle, exercise and develop the necessary skills for release.

Proper Nutrition

- Adequate supply of bird food catered to all different types of birds including different diets for birds of different species and ages as well as access to fresh water.

Education and Outreach

- Resources and programs to educate the public of bird conservation, the importance of rehabilitation and ways to prevent bird injuries and promote bird welfare.

Release and Post-Release Monitoring

- Collaborating with conservation organizations for safe and appropriate release of rehabilitated birds and possible monitoring of their progress after release

Funding and Donations

- Financial support through donations, grants and sponsorships to cover operating expenses, medical supplies, food and facility maintenance.

Specifics of the Lewes Bird Rehabilitation Center

4 flight Cages

- 2 Raptor/Osprey Cages (Large birds)
- 2 Sea bird/Song bird Cages (Medium/Small birds)
- Flight cage requirements 100' x 25' x 30'
- Raptor cages must be configured in an "L" shape so the birds may perform sharp turns necessary for hunting while they rehabilitate

3 Waterfowl Ponds

- Rehabilitation ponds must be minimum 2,150sq/ft to allow birds to swim, dive and move around with ease
- Must include caging around pond to prevent escape and attacks from outside predators
- Planting buffer in between cages to allow birds to recover in a stress free environment

Significance of Cape Henlopen State Park

Cape Henlopen State Park holds significant importance for both birds and birdwatchers. The state park is located along the Atlantic Flyway, a major migratory route for birds that spans the East Coast of North America. Cape Henlopen serves as a critical stopover site for numerous bird species during their long-distance journeys.

The park's diverse habitats, including tidal salt marshes, sandy beaches, dunes, forests, and freshwater impoundments, attract a remarkable variety of birds throughout the year. During migration seasons, Cape Henlopen becomes a haven for migrating birds, providing them with essential resources such as food, water, and shelter. It offers resting and refueling opportunities for both songbirds and waterfowl, making it a prime location for birdwatchers to witness impressive numbers and species diversity.

The state park also has a strong emphasis on its role in conservation efforts. The park's protected status ensures the preservation and maintenance of vital bird habitats, contributing to the overall health of local bird populations and biodiversity. The diverse range of birds that inhabit the area includes waterfowl like ducks, geese, and swans, as well as shorebirds, raptors, songbirds, and seabirds.

Visitors can engage in various activities such as hiking, biking, guided bird walks, and educational programs that promote an appreciation for birds and their conservation. Additionally, the data collected by birdwatchers at Cape Henlopen State Park contributes to scientific research, monitoring efforts, and conservation initiatives, helping to protect these valuable habitats and the birds that depend on them.



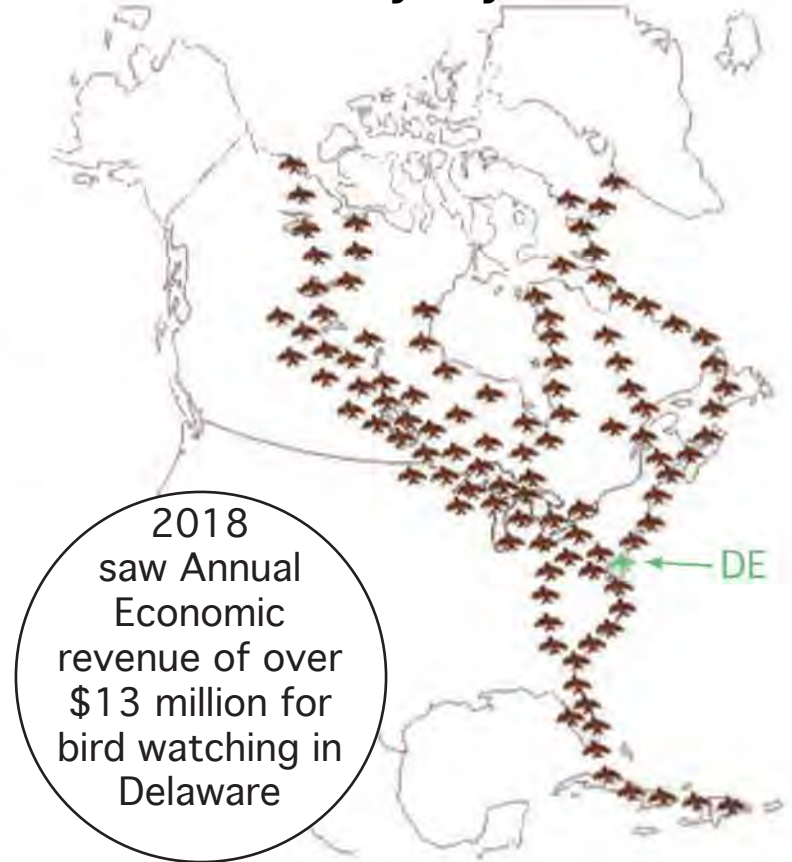
Birding in Delaware

Birding, also known as bird watching, is a popular hobby and recreational activity that involves observing and studying wild birds in their natural habitats. Birders, equipped with binoculars, field guides, and often cameras, venture into various ecosystems such as forests, wetlands, and parks to spot and identify different bird species. They may listen to birdsong, watch their behaviors, and document their sightings. Birding offers a rewarding way to connect with nature, appreciate the beauty of birds, and expand one's understanding of avian diversity and ecosystems.

Delaware, is home to a vibrant birding community. With its diverse habitats including coastal areas, marshes, forests, and open spaces, Delaware attracts a significant number of bird watchers. The state is located along the Atlantic Flyway, a major migratory route for birds, enhancing the birding experience, as birders have the opportunity to observe a wide variety of species during migration seasons. Delaware also boasts several important birding sites and preserves that draw enthusiasts, such as Bombay Hook National Wildlife Refuge and Cape Henlopen State Park. Whether residents or visitors, many people in Delaware actively participate in birding, contributing to the local birding community, citizen science projects, and the conservation of avian species and their habitats in the state.

For birdwatchers, Cape Henlopen provides an opportunity to observe and study many different bird species in their natural environment.

Atlantic Flyway



A place for Bikers to relax and enjoy

Having a bike rest stop at the new Lewes Birding and Biking Center can provide several benefits for bikers while supporting local businesses. The biking center is located next to Cape Henlopen State Park where there is already a complex trail system. The bike rest stop will provide bikers with a convenient place to take a break and rest before continuing their journey. The biking center will attract more bikers to the area while increasing foot traffic for local businesses. Additionally, the bike rest stop will provide bikers with a safe place to stop and make any necessary adjustments to their bikes, this will help prevent accidents and injuries. The bike rest stop includes an area where bike tools will be available for use freely. By using the existing sand drying beds, bikers will be able to easily ride up and repair the bikes. The station will have an array of different tools helpful for bikers who need to make minor repairs.

Needs for a biking facility include:

- Restrooms
- Water and hydration stations
- Shelter
- Seating
- Bike racks
- Informational displays
- First-aid kit
- Bike tools



Benefits of Constructed Wetlands

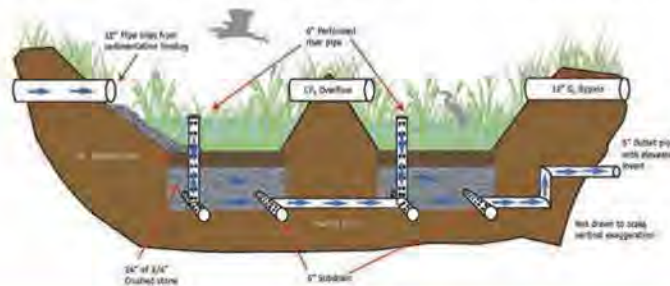
A constructed wetland is a man-made ecosystem designed to mimic the functions of a natural wetland. It consists of a shallow basin or series of basins filled with soil, gravel, sand, and plants that are specially chosen for their ability to absorb and break down pollutants.

Constructed wetlands can be used to treat greywater, which is wastewater from household activities such as washing dishes, clothes, and bathing. Greywater is typically high in organic matter, nutrients, and some potentially harmful contaminants, but it can be treated and reused for non-potable purposes such as irrigation, flushing toilets, and washing cars.

In a constructed wetland, greywater is pumped into the basin and allowed to flow through the soil and vegetation. As it passes through the wetland, the organic matter and nutrients in the greywater are absorbed by the plants and microorganisms in the soil. The plants also release oxygen into the water, which helps to support aerobic bacteria that break down pollutants.

Over time, the wetland system can effectively remove pollutants from the greywater, producing cleaner water that can be reused for non-potable purposes. The treated greywater can also provide benefits such as increased plant growth and wildlife habitat in the wetland.

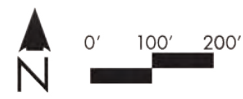
Constructed wetlands are a cost-effective and environmentally friendly way to treat greywater, reducing the strain on wastewater treatment facilities and promoting water conservation. However, they require proper design, construction, and maintenance to ensure their effectiveness and prevent the risk of contamination or other environmental problems.



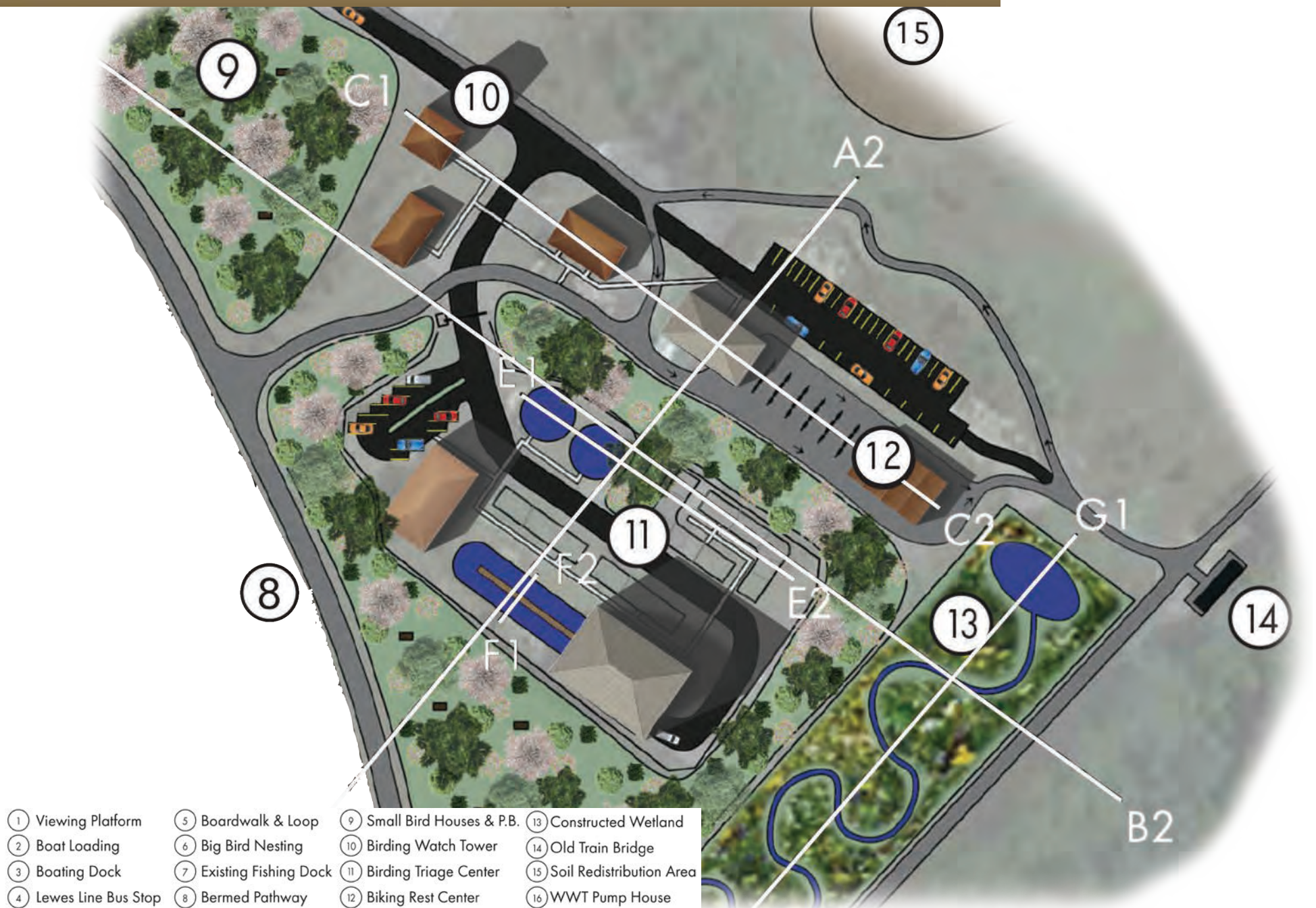
Final Design



Master Plan

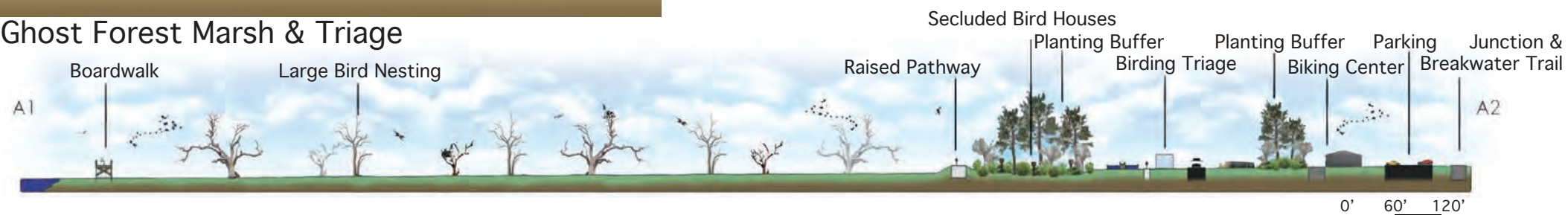


The Lewes Birding and Biking Center

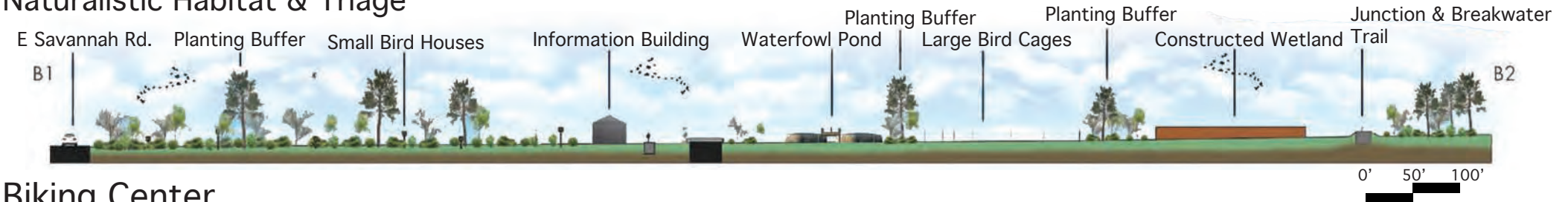


Sections

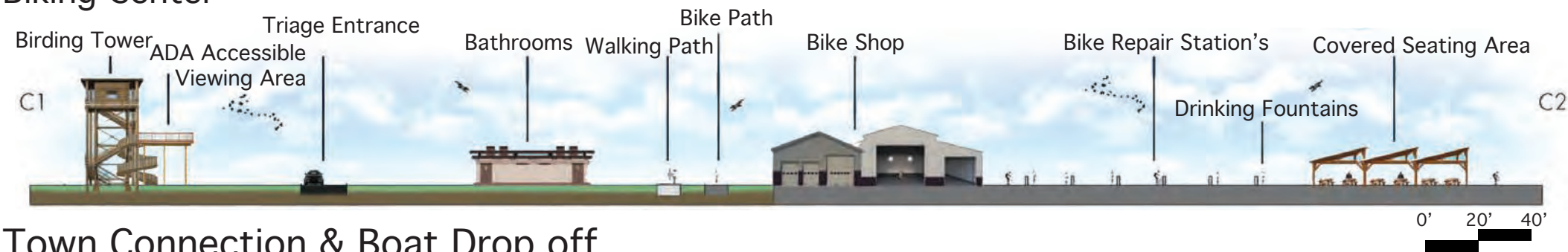
Ghost Forest Marsh & Triage



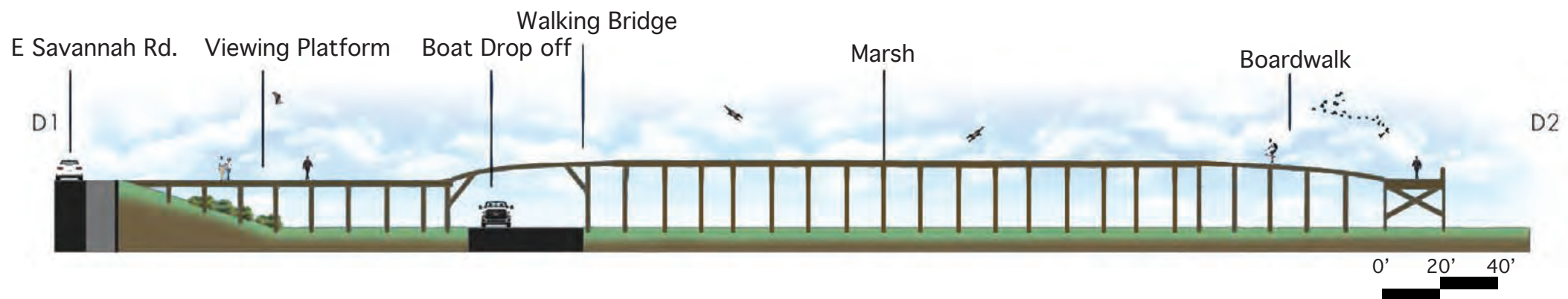
Naturalistic Habitat & Triage



Biking Center

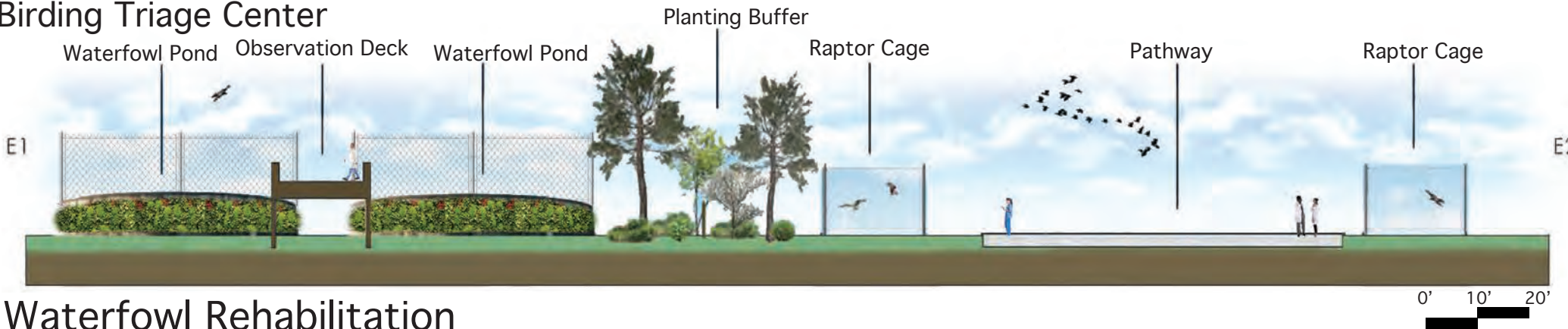


Town Connection & Boat Drop off

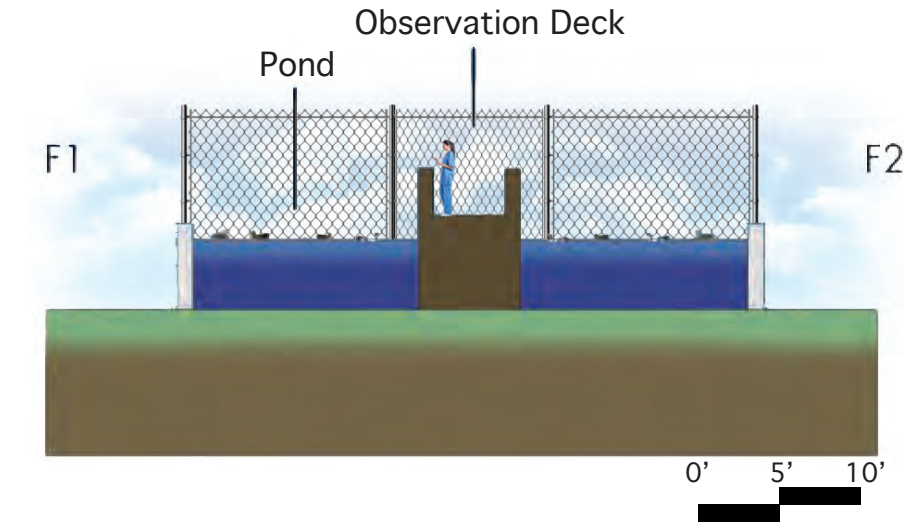


Sections

Birding Triage Center



Waterfowl Rehabilitation



Constructed Wetland Plantings



Constructed Wetland



Perspectives

Bike Rest Area

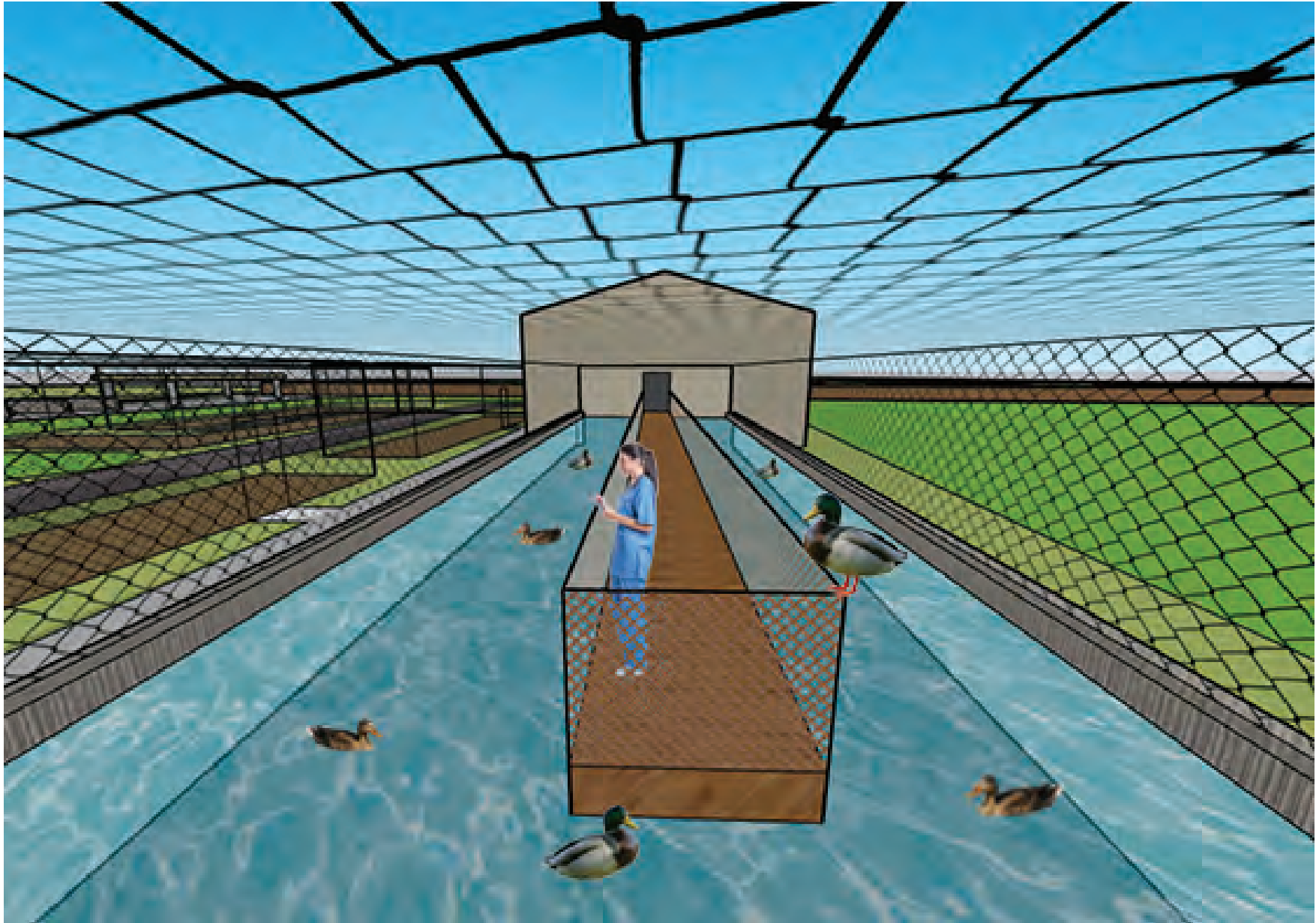


Perspectives

Birding Triage



Perspectives/Model



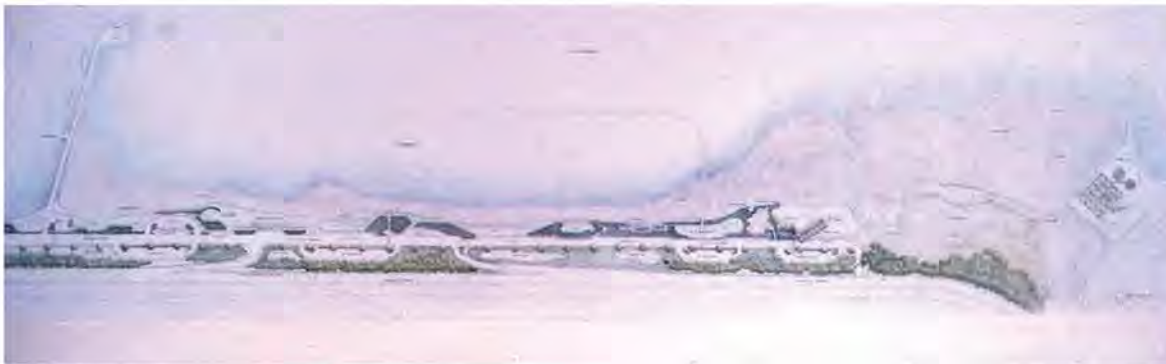
Case Studies and Research



Case Study - Long Wharf Park

The master plan also investigated a number of possibilities for reusing the defunct water treatment facility at the south end of the park including reusing the buildings as an aquaculture facility. Michael Singer was subsequently involved in the evolution of the project through 1998 and helped to support the implementation of several of the following project components.

In 1994 the New Haven Land Trust and the Garden Club of New Haven created Long Wharf Nature Preserve restoring 24 acres of mud flats, dunes, salt marshes and upland habitat at the southern end of Long Wharf Park. The land was donated by the City of New Haven and remains a model precedent of urban ecological regeneration. The site includes a trail system and an informational panoramic display of the Harbor and New Haven's East Shore. In 2011 the New Haven Land Trust fought off a land grab by the Connecticut Department of Transportation to seize part of the preserve for a new I-95 off ramp.



Research - Constructed Wetlands

“Can Constructed Wetlands be Wildlife Refuges? A Review of Their Potential Biodiversity Conservation Value”

By: Chengxiang Zhang

There is a potential for constructed wetlands to be used as habitats for wildlife and their conservation value. Constructed wetlands are human-made ecosystems designed to mimic natural wetlands and can be used for wastewater treatment, flood control, and other purposes. Zhang reviews existing literature on the biodiversity of constructed wetlands, including studies on the presence of different species of plants, invertebrates, and vertebrates.

Zhang finds that while constructed wetlands may not support the same level of biodiversity as natural wetlands, they can still provide valuable habitat for a wide range of species, including birds, insects, and amphibians. He notes that the conservation value of constructed wetlands is closely linked to their design and management, with features such as water depth, vegetation composition, and water quality affecting their potential to support wildlife. Zhang concludes by suggesting that constructed wetlands can serve as important tools for wildlife conservation, but that further research is needed to understand their potential and to optimize their design and management for conservation purposes.

Research - Constructed Wetlands

“Constructed Wetlands for wastewater treatment”

By: Jan Vymazal

The article discusses the use of constructed wetlands as a sustainable and cost-effective method for treating wastewater. An overview is included of the basic principles of constructed wetlands and how they can be used to remove pollutants from wastewater. Various types of constructed wetlands including;

- Horizontal or vertical wetlands
- Subsurface or aboveground wetlands
- Free water constructed wetlands

Each wetland has different applications that can be applied to the environment. The benefits of constructed wetlands include low energy requirements, low maintenance costs, and the potential for wastewater reuse. A key point of the article is that constructed wetlands can effectively remove a wide range of pollutants from wastewater. These materials include;

- Organic matter
- Nutrients
- Heavy metals
- Pathogens

The article emphasizes the importance of proper design and operation of constructed wetlands to ensure optimal treatment performance.

Research - Wildlife Refuge

“Artificial refuges for wildlife conservation: what is the state of the science?”

By: Mitchell A. Cowan

I read about the current state of research on the use of artificial refuges for wildlife conservation. Artificial refuges are human-made structures designed to mimic natural habitats and provide shelter and breeding sites for wildlife. These structures can take many forms, including nest boxes, artificial reefs, and floating wetlands, and are often used to compensate for the loss or degradation of natural habitats due to human activities.

Cowan reviews the scientific literature on artificial refuges and finds that while they have the potential to provide important habitat for wildlife, their effectiveness depends on a variety of factors, including design, placement, and maintenance. He notes that many studies have focused on the use of nest boxes for birds and bats, and while these structures have been shown to be effective in some cases, there is still much to be learned about their optimal design and placement. Cowan also highlights the need for more research on the use of artificial reefs and floating wetlands, particularly in marine and aquatic environments where natural habitats are particularly vulnerable to human impacts. Overall, the article emphasizes the importance of continued research and monitoring to understand the effectiveness of artificial refuges for wildlife conservation and to optimize their design and management for maximum benefit.

Case Study – Russell Peterson Wildlife Refuge

The Russell Peterson Wildlife Refuge is a wildlife area located in Wilmington, Delaware, along the Christina River. It covers over 200 acres of land and water. It includes tidal marshes, wooded areas, and open fields.

The primary purpose of the Russell Peterson Wildlife Refuge is to provide habitat for a variety of wildlife species and to promote conservation and restoration efforts. The refuge is home to over 200 species of birds, including bald eagles, ospreys, and great blue herons. It also supports a variety of other wildlife.

One of the main benefits of the refuge is its recreational opportunities. The refuge offers a variety of activities for visitors, such as hiking, birdwatching, fishing, and kayaking. The trails throughout the refuge provide access to the natural beauty of the area, while also promoting physical fitness and mental well-being.

Another benefit of the Russell Peterson Wildlife Refuge is its educational opportunities. The refuge offers a variety of educational programs for visitors of all ages, such as guided nature walks, birdwatching classes, and hands-on activities for children.

The Russell Peterson Wildlife Refuge serves as an important site for scientific research and monitoring. The refuge provides a natural laboratory for scientists and researchers to study wildlife populations, habitat restoration, and other environmental issues.

Research - Wildlife Refuge

“The Significance of National Wildlife Refuges in the Development of U.S. Conservation Policy”

By: Robert Fischman

The article argues that the National Wildlife Refuge System played a crucial role in shaping American attitudes towards wildlife conservation and was instrumental in the development of key conservation policies in the United States. Fischman traces the history of the refuge system, starting with the establishment of Pelican Island National Wildlife Refuge in Florida in 1903, and examines its evolution over time. He notes that the refuge system was originally created to protect migratory birds, but has since expanded to encompass a wide range of wildlife and their habitats.

Fischman discusses the legal and policy framework that underpins the refuge system, including the National Wildlife Refuge System Administration Act of 1966, which established a cohesive network of lands and waters dedicated to the conservation of wildlife and their habitats. He also examines the challenges facing the refuge system, such as habitat loss and fragmentation, and the need for increased funding and public support. Fischman concludes by emphasizing the ongoing importance of the refuge system in protecting and conserving America's wildlife and natural resources, and the need for continued attention and investment to ensure its continued success in the face of future challenges.

Case Study - Cape Henlopen State Park

Cape Henlopen State Park is a popular tourist destination located in the state of Delaware, known for its stunning natural beauty and diverse wildlife. The park is situated on a peninsula that extends into the Delaware Bay and is home to a variety of habitats, including sandy beaches, dunes, wetlands, and forests. This unique blend of ecosystems provides an ideal environment for a wide range of wildlife species, making Cape Henlopen a crucial center for wildlife conservation in Delaware.

Cape Henlopen State Park is home to a huge variety of bird species, over 300 different species have been recorded in the state park. The park is a vital habitat for many different bird populations throughout the year.

The park is particularly significant as a breeding and migratory stopover site for a variety of bird species. Every year, thousands of shorebirds, waterfowl, and raptors pass through Cape Henlopen during their migrations along the Atlantic Flyway. The park's beaches and dunes also serve as nesting sites for threatened and endangered species such as piping plovers and red knots. In addition to birds, the park is home to a variety of mammals, reptiles, and amphibians, including white-tailed deer, red foxes, and box turtles. The diverse wildlife found in Cape Henlopen highlights the importance of the park as a natural sanctuary in the midst of an increasingly developed area.



Case Study – Tri-State Bird Rescue & Research

Tri-State Bird Rescue & Research is a nonprofit organization based in Newark, Delaware, that provides wildlife rehabilitation services to injured, sick, and orphaned birds, as well as education and research programs. Founded in 1976, Tri-State has become a leader in avian rehabilitation and is recognized nationally and internationally for its expertise and innovation. The organization's mission is to “rescue, rehabilitate, and release injured, orphaned, and oiled wild birds while providing compassionate care to all animals entrusted to us.”

Tri-State operates a state-of-the-art wildlife rehabilitation center that is equipped to provide medical care, rehabilitation, and long-term housing for a wide range of bird species. The center is staffed by a team of highly trained professionals, including wildlife rehabilitators, veterinarians, and biologists, who work together to provide the best possible care for their patients. In addition to rehabilitation services, Tri-State also conducts research on wildlife health and rehabilitation techniques, as well as education and outreach programs for the public and professionals.

Overall, Tri-State Bird Rescue & Research plays an important role in protecting and conserving bird populations in Delaware and the surrounding states. The organization's commitment to compassionate care, innovative research, and community engagement has made it a valuable resource for wildlife conservation efforts.

Research - Bird Rehabilitation

“Center For Bird Rehabilitation And Public Education In The Union Bay Natural Area”

By: Natalia Huguelet

This article proposes the construction of a new facility in Seattle, Washington, that would serve as a bird rehabilitation center and public education space. The facility would be located in the Union Bay Natural Area, a popular birdwatching and recreational area that is home to a diverse array of bird species.

The proposed center would serve several important functions, including providing medical care and rehabilitation for injured and sick birds, conducting research on bird health and ecology, and offering educational programs for the public. The facility would be designed to provide a comfortable and safe environment for the birds in its care, with features such as climate-controlled indoor spaces, outdoor aviaries, and flight cages. The center would also offer opportunities for visitors to learn about birds and their habitats, through exhibits, guided tours, and educational programs. Overall, the article highlights the importance of bird rehabilitation and public education in promoting conservation and sustainability, and suggests that a new facility in the Union Bay Natural Area would be an ideal location for such a center.

“Economic Benefits from Biking Trails and Greenways”

By: Kalyan Chakraborty

This article discusses the economic benefits that can be derived from the development of biking trails and greenways. The article highlights several ways in which these amenities can contribute to local economies, including by attracting tourism, promoting physical activity and health, and increasing property values.

One of the key benefits of biking trails and greenways is their ability to attract tourism and generate revenue for local businesses. Studies have shown that communities with well-developed biking infrastructure tend to see an increase in tourist activity, with visitors spending money on lodging, food, and other goods and services. In addition, biking trails and greenways can help to promote physical activity and health, which can lead to reduced healthcare costs and increased productivity among residents. Finally, these amenities can also have a positive impact on property values, with homes located near biking trails and greenways often commanding higher prices than those in other areas. Overall, the article argues that the development of biking trails and greenways can have significant economic benefits for communities, and that policymakers should consider these benefits when making decisions about transportation and recreation infrastructure.

Case Study - Cape Cod Rail Trail

The Cape Cod Rail Trail is a 22-mile biking trail located on Cape Cod in Massachusetts. It is a former railroad line that has been converted into a multi-use trail for biking, walking, and running. The trail is mostly flat and runs through wooded areas, cranberry bogs, and along the coastline. It is a popular tourist attraction in the area and is used by both locals and visitors. In addition to providing a scenic and enjoyable biking experience, the Cape Cod Rail Trail also brings economic benefits to the area. Local businesses, such as bike rental shops, restaurants, and hotels, benefit from the increased tourism that the trail brings. The trail also provides opportunities for outdoor recreation and exercise, which can have positive impacts on public health.

Furthermore, the Cape Cod Rail Trail is a sustainable form of transportation that helps to reduce carbon emissions and promote environmental stewardship. Biking and walking are low-impact activities that do not require the use of fossil fuels, which reduces the carbon footprint of transportation. By providing a safe and convenient biking trail, the Cape Cod Rail Trail encourages more people to choose sustainable transportation options. In addition to the environmental benefits, biking and walking also promote social interaction and community building. Overall, the Cape Cod Rail Trail is an important asset to the community, providing economic, health, environmental, and social benefits to residents and visitors alike.



Research - Biking

“Active Living and Biking: Tracing the Evolution of a Biking System in Arlington, Virginia”

By: Royce Hanson and Garry Young

This article discusses the development of a biking system in Arlington, Virginia, and the role that active living policies played in its evolution. The article traces the history of biking infrastructure in the county, highlighting key developments such as the creation of bike lanes, trails, and parking facilities. The authors also examine the role that planning and policy decisions played in the development of the system, including the adoption of a Complete Streets policy and the creation of a Bicycle Advisory Committee.

The article argues that the development of a biking system in Arlington was driven by a combination of grassroots activism, political leadership, and effective planning and policy decisions. The authors suggest that the county's success in developing a biking system can serve as a model for other communities looking to promote active living and sustainable transportation. They also note that the benefits of biking infrastructure go beyond transportation, with studies showing that access to biking facilities can have positive impacts on public health, the environment, and the economy. Overall, the article emphasizes the importance of active living policies in promoting sustainable transportation and creating healthier, more livable communities.

Works Cited

- Hanson, R., & Young, G. (2008). Active living and biking: Tracing the evolution of a biking system in Arlington, Virginia. *Journal of Health Politics, Policy and Law*, 33(3), 387–406. <https://doi.org/10.1215/03616878-2008-002>
- Chakraborty, K. (2019). Economic benefits from biking trails and greenways. *Business and Economic Research*, 9(2), 199. <https://doi.org/10.5296/ber.v9i2.14727>
- Huguelet, N. (2021). Center For Bird Rehabilitation And Public Education In The Union Bay Natural Area. *Architecture_MPS*, 25(1), 143-152.
- Fischman, R. (2005). The significance of National Wildlife Refuges in the development of U.S. conservation policy. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.699482>
- Cowan, M. A., Callan, M. N., Watson, M. J., Watson, D. M., & Doherty, T. S. (2021). Artificial Refuges for wildlife conservation: What is the State of the science? *Biological Reviews*, 96(6), 2735–2754. <https://doi.org/10.1111/brv.12776>
- Zhang, C., Wen, L., Wang, Y., Liu, C., Zhou, Y., & Lei, G. (2020). Can constructed wetlands be wildlife refuges? A review of their potential biodiversity conservation value. *Sustainability*, 12(4), 1442. <https://doi.org/10.3390/su12041442>
- Vymazal, J. (2010). Constructed wetlands for wastewater treatment. *Water*, 2(3), 530–549. <https://doi.org/10.3390/w2030530>

Works Cited

- Tri-State Bird Rescue and Research. (2023, April 19). About Tri-State. Home - Tri-State. <https://tristatebird.org/>
- Daly, J., & Howey-Newcomb, A. (2023, April 19). Interviewing Clinic Director Andrea Howey-Newcomb. Learning the specifics and needs for bird rehabilitation at Tri-State Bird Rescue and Research. other.
- Michael Singer . (2016, June 1). Long wharf park master plan. Michael Singer Studio. <https://www.michaelsinger.com/project/long-wharf-park-master-plan/>
- Davis, Luise. "A Handbook of Constructed Wetlands." EPA, 6 Oct. 2016, 19january2021snapshot.epa.gov/wetlands/handbook-constructed-wetlands_.html.
- "Canalfront Park and Marina." Plaque Artwork-01, www.ci.lewes.de.us/212/Canalfront-Park-and-Marina. Accessed 18 May 2023.
- Driscoll, Ellen, and Nick Roth. "Wind, Water Inundate Cape Region." Cape Gazette, 29 Oct. 2021, www.capegazette.com/article/wind-water-inundate-cape-region/229752.
- Delaware State Parks. "Cape Henlopen State Park." Delaware State Parks, destateparks.com/Beaches/CapeHenlopen. Accessed 18 May 2023.
- "Russell W. Peterson Wildlife Refuge." Riverfront Wilmington, 19 Nov. 2019, riverfrontwilm.com/directory/russell-w-peterson-wildlife-refuge/.

Conclusion

With the implementation of this project I will be able to adaptively reuse the defunct Howard H. Seymour WTP. The site will become a recreational space with an emphasis on bird rehabilitation, birding and biking for the town of Lewes to enjoy. By using an existing rail line a raised pathway will be implemented into the design that will be the physical barrier protecting the center from sea level rise. The pathway will also protect the residential housing that will be affected by sea level rise located behind the center. The rest of the implemented trail connecting to the raised pathway will be a boardwalk so that the tidal marsh will remain unaffected.

The addition of a ghost forest will add a new aesthetic to the marshland and provide birds a natural area to nest. This area will all be visible from the implemented birding watch tower that will provide birders with a new vantage point to view all different types of birds from a safe distance.

The biking rest area will allow bikers to stop and rest under a covered pavilion. Bikers will be able to repair their bikes for free by reusing the existing sand drying beds as a ride in repair station. The area will feature a bike shop, bike racks, air pumps, water drinking fountains and a restroom.

The bird rehabilitation center will be closed to the general public to ensure the injured birds are able to rehabilitate safely and with minimal stress. With a focus on water fowl rehabilitation the triage will be a satellite facility for Tri-State Bird Rescue and Research, a state of the art facility that is in need of waterfowl rehabilitation ponds.

The Lewes Birding and Biking Center will be an attraction for all the townspeople and visitors of Lewes and add to the economic value of the town.