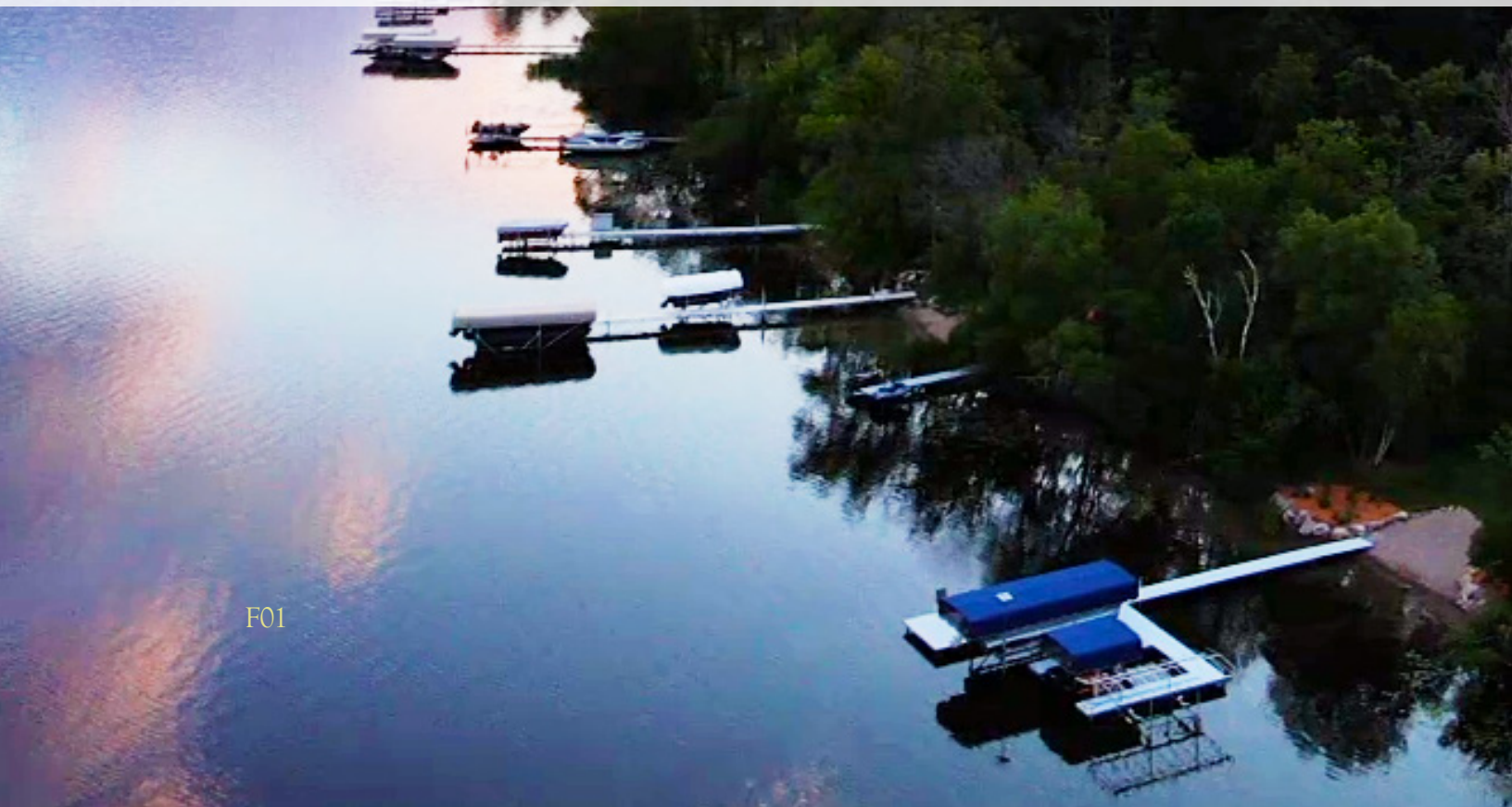




Lakeshore Design Intervention

Jacob R. Miller

Thesis Proposal & Research
2020-2021



F01



Contested Ground: Lakeshore private Interests Versus the Public Good

A Design Thesis Submitted to the Department of Architecture &
Landscape Architecture of North Dakota State University

By:

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In Partial Fulfillment of the Requirements for the
Degree of Masters of Landscape Architecture

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May 2021
Fargo, North Dakota



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Thesis Abstract

This study will quantify the Minnesota County's concerns with shoreline development and private landowner's concerns with the unauthorized use of purchased land due to regulations and wildlife preservation. This study aims to determine what will satisfy the needs of private interests versus the public good in relation to the common Minnesotan lakeside real-estate development problems. This study will investigate the county's concerns with shoreline development on wetlands and bluffs.

The reason this study is being conducted is since landowners who want to develop their shoreline cannot do so since the state or county has all the jurisdiction in what they can and cannot do, even though it is paid for by the landowner. I want to incorporate the wildlife concerns with private interests to create a design that satisfies the needs of both. To be able to reduce the environmental risks in protected habitats to create a more sustainable, yet still visually pleasing design that will satisfy the landowners and go by the laws of the protected areas. A hidden fact about private lakeside owners is that knowingly or not, they illegally develop in prohibited areas, and most of the time they do not get caught, and even if they do the county will most likely not make them remove it.

The methodology I will use to configure this data will be done through several case studies, state and county codes and laws, and possible online interviews with county wildlife law enforcers. There will need to be a study for how much land is private and public, and an estimated study for the percentage of private owners can develop down to their shoreline and how many cannot. With this data I will develop a mitigation strategy to find a private and public balance of shoreline development that will provide and satisfy landowners with more development options for their privately owned land but will also satisfy the county's environmental concerns, thus proposing the perfect ratio for public and private estates, and if need be, advocate for changing the existing wildlife restrictions.



Thesis Narrative

Since the dawn of time, nature has and always will have a hold of what happens in the world. The word “nature” is often hard to phrase. Humans have changed the world in countless ways making it impossible to distinguish from what is and is not unaffected by humans. There are things we humans can and can not control, like how lakes flood and cause property damage or other natural disasters, but there are things we can control and will benefit “nature”. The state and county wildlife preservations and restrictions have their benefits, but are there restrictions too restricted? Or are there ways we can work these to benefit both the private and public good?

Some of the influential reasons I am pursuing this theoretical premise bounce around what I have seen growing up in the upper Midwest. I have seen how the state or county laws have bullied landowners into submitting to the laws, even if a landowner has probable cause. I have seen first-hand how the state and county restrictions have limited and frustrated the public. Even though their restriction does mean well, there are no ways around what they think is right. To dive deeper, this is an example of what I have seen living on North Long Lake in Nisswa. I helped with a redesign for a backyard with hardscapes and softscapes, but before construction went underway, we wanted to make sure it was legal through the county. After inspection, we were informed that half of the design would not be able to happen because it is in a wetland. Even if with a steadier solution of helical piers raising a shed above the ground so water may pass under it, still could not happen.

This is one example: I have seen countless other examples in the Brainerd lakes area where landowners are restricted by regulations. Landowners with shoreline erosion and lake sedimentation are constantly losing their land, and even with a natural aquatic barrier, it is not enough.



Landowners can have rip-rap (human-placed rock or other material used to armor shorelines) but they are only allowed so much beach for this. In some areas the erosion will wrap around these areas, thus losing landowner's land and leisure. Landowners are so frustrated with what they can and can not do nowadays they do not care about the state or county laws because they already know the answer and put unsustainable structures or other amenities in wetlands and other habitats. People are outraged by the fact that their privately owned land is secretly still owned by someone else when it comes to construction. Therefore, I want to step in. I want to make a reasonable solution for the people that will still satisfy wildlife concerns. If someone does not step in and find the middle ground for public and private owners, private owners are going to take it into their own hands and go behind the state and county. Yes, most people do get away with their own construction, but they do not understand the wildlife concerns, how their design can be harmful to habitats, or any other preservations.

Project Typology

Ecological Restoration



Residential Lakeshore Design



Socio-economic Landscapes



Wildlife Mitigation



Major Project Elements

Wetlands

Wetland protection legislation, enhancements, and wetland design

Shoreline Erosion

Bluffs, and erosion management and prevention

Rain Gardens

Manage storm water runoff, and a visual solution for protected sites

Integrating Indoor & Outdoor Living

Ecological designs and spaces that benefit homeowners

Helical Piers

Structure alternatives for elevated surfaces, boardwalks, etc.

Septic Systems

Proper management and placement of the drain field in designs

Tree Management Altercation

Shoreline management of pruning removing and dead trees

Construction Permits

General guidelines for residential shoreline permitting

Deregulation

Minimize overlapping authority to propose one governing agency

Client List

The potential clients for this thesis include the Minnesota Department of Natural Resources (MnDNR), Environmental Protection Agency (EPA), Information for Planning and Consultation (IPaC), Bureau of Land Management (BLM), landowner associations, and general contractors. This project will most likely be open to the public for Residential designs and for the MnDNR to use for mitigation strategies.

User Description

This project will primarily be used for landowners who are developing their shoreline. Potential user groups include residential and commercial lakeshore properties, landscape installers landscape designers, civil engineers and excavation companies.



Site Information

Location: Brainerd Lakes Area | Minnesota | United States of America

Site Typology: Rural | Lakefront | Residential | Natural | Coniferous Forests

Climate: Warm-summer Humid Continental

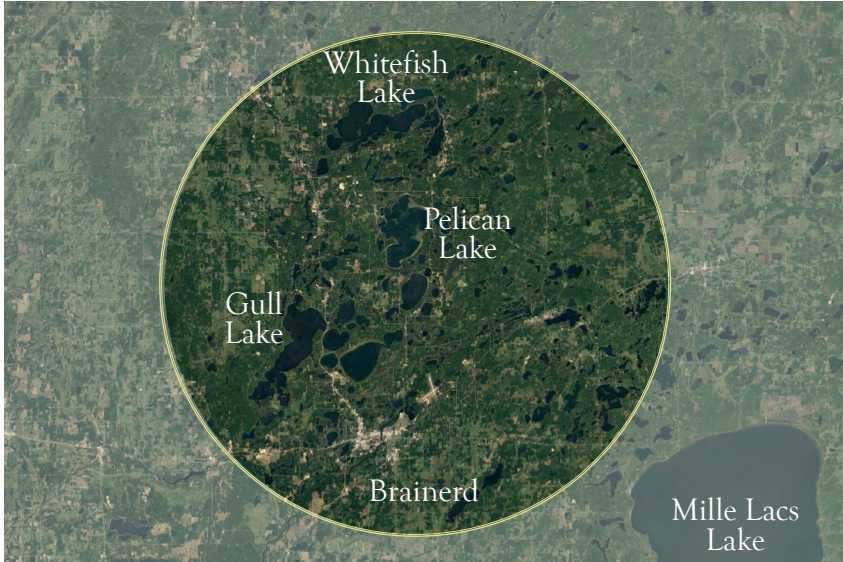
Ecosystem: Macro - Laurentian Mixed Forest
Micro - Mille Lacs Uplands, Pine Moraines & Outwash Plains

Status: The economy increases yearly, along with the amount of tourism. Campgrounds and landowners have less land every year due to erosion. Common lakes water heights are at their lowest and highest due to poor dam management.

Note: Soils are 8 - 18% clay and 45 - 65% fine sand or coarser material.



F10



F10

Project Emphasis

Laws & Regulations

Redefine standards for what is contractors are allowed to install in protected habitats. Thus, making ecological solutions that will please the public and private interests.

Ecosystem Restoration

Renew and restore degraded, damaged, or destroyed ecosystems and habitats by correct landscape design tactics.

Landscape Design

Use sustainable design and installation tactics to build, and plant functional landscape for each habitat located on owned land. An example of this would be a rain garden.

Erosion Restoration

Restore and control eroded sites or bluffs derived from civil engineering such as plantings, retaining walls and terraces or diversions.

Public & Contractor Education

Educate and instruct landowners and contractors in their future designs about the importance of proper installation in a habitat.



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Project Goals

- 1) Eco-friendly Designs
- 2) Redefine Habitat Safety in Designs
- 3) Law Abiding Installations
- 4) One Governing Wildlife Agency
- 5) Public & Private Common Ground

The extent of this thesis project aims to provide more freedom and possibilities through newer and better environmentally friendly designs and installations for the lakeside residents of the Brainerd Lakes area. I hope for this research to guide a new theory of designs that abide by the wildlife and habitat laws. I hope to also propose new alternatives for eco-friendly designs that will make the preexisting districts rethink and hopefully rewrite what can be done in the habitats of the Brainerd Lakes area.

Another goal is to redefine and deregulate the overlapping authority of the many districts that control what residents can and can not install on their own property. I wish to propose having one set of a governing agency that will govern over all of the wildlife departments making it more user-friendly for when a contractor or installer is proposing a new design. After these goals are met, they will establish a better relationship between the public and private interests.



Research Plan

Definition of a Research Direction

The research will be done by analyzing the preexisting laws and ordinances by the state and county government and locating the direct sections that direct towards shoreline development. Then, analyzation of plant species, soil types, climate, drainage, and habitats in chosen areas to determine what alternatives can be proposed in a design that preexisting regulations state can not be done, but theoretically can be in a new eco-friendly design plan.

Design Methodology

Throughout this design process, the use of mixed methodologies will be used to determine the outcome of this thesis design. For the duration of this project the following methods will be explored and conducted; qualitative and quantitative research, case studies and combines strategies, and logical argumentation.

The combined use of these methods will guide the design of this thesis to reach its end objectives and goals. Furthermore, a developed site context model will be made for SketchUp to provide insight into the possible environmental changes that could be made in the hierarchy of the thesis.

Research Plan

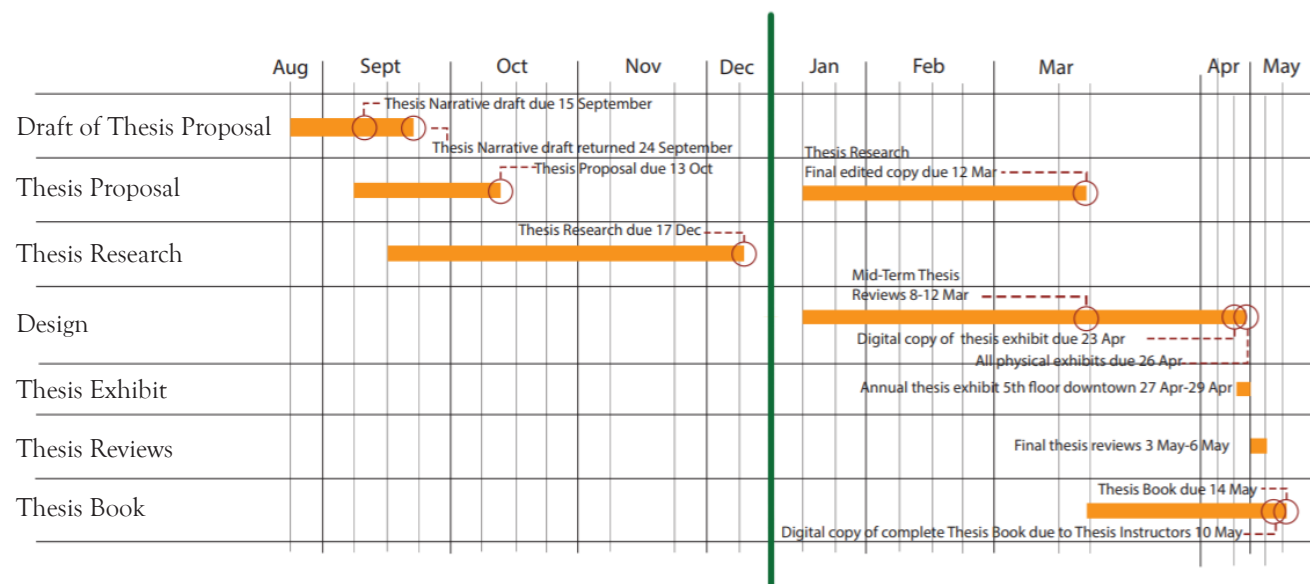
Design Process Documentation Plan

All research and designs will be conducted digitally with the exception of a brief site analysis that will be applied into the thesis program and proposal. The documentation will be demonstrated in the following methods:

- 1) Online and External Storage
- 2) Institutional Repository of Proposal, Book, & Presentation
- 3) Oral & Visual Documentation

Landscape Design Process

- 1) Proposal for Landscape Design
- 2) Site Plan Development
- 3) Concept Plan Development
- 4) Final Plan Development (GIS)



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Research Results

Theoretical Premise

As the progression of sub-urban and rural counties progress with the establishment of lakeside and riverside districts, it is of the most importance to specifically define what can and con not be constructed by the definition of ecological designs for residential and commercial properties. The importance of understanding why wildlife codes and laws are made should be one of the first design factors in all designs. Not understanding what can and what is harmful to the environment can be a dangerous slope for contractors and design firms for the safety of foundations of the property and nature itself.

For every lakeshore design there are permits that are needed in order to properly if a design is safe to ensure further construction. Each county has its own set of rules that may be the same or different than the State's legislation. This premise will give understanding to if a client were to build on their property, they would have to go through the State, and their county for permits. This makes life difficult for land owners and contractors to estimate when construction will start, and if there are design changes that are needed. Minnesota's setbacks and guidelines are an overall approximation of the standards by each county, therefor why would each county have their own set of restrictions, other than making it for challenging and time consuming for landowners.

In order to draw a conclusion on what changes should be made to the legislation hierarchy itself, there has to be change to restrictions of their legislations itself. There are countless restrictions and setbacks that some are very reasonable, and some are not. With modern day technology, there are factors that need to be implemented in the restrictions of the State and county. The results of this will shed light on what and what can not be done when designing on lake shores in the Crow Wing County, while giving advise to designers on what is an eco friendly design that is still pleasing to the landowners. Furthermore, how can a new legislation be made to truly combine the State of Minnesota and will not vary per county to help speed up and clarify new designs for lakeshore properties of Minnesota.

Research Types

Case Studies and Combines Strategies

- I) Using lakeshore and wetland projects as justification for research and design methods

Quantitative Research

- I) Defining restriction and setbacks for lakeshore design
- II) Properly define native, wetland, and soil erosion vegetation of the Crow Wing County
- III) Benefits of modern technology

Qualitative Research

- I) MnDNR conference
- II) Crow Wing County conference

Logical Argumentation

- I) Arguing the benefits of utilizing modern day technology for more beneficial designs for landowners
- II) Arguing the benefits of a combined legislation

Literature Review

2014 Water Protection Report

Crow Wing County Land Services Department, Environmental Services Division, State of Minnesota, Department of Natural Resources, 2014.

Overview

This article firstly discusses the importance, and what the state and county are doing to prevent water pollution, and to stabilize the community that lives on lakes. Secondly, this article will calculate and discuss the permitting authority in the area, and the activity of these permits being called in. This article is important for this thesis because it will demonstrate how often, and how few permits are being called in for lakeshore development, the reasons behind this are either lake homeowners understand that they can not just do what they want to their lake property, or homeowners do not care to get a permit because they know it will be shut down.

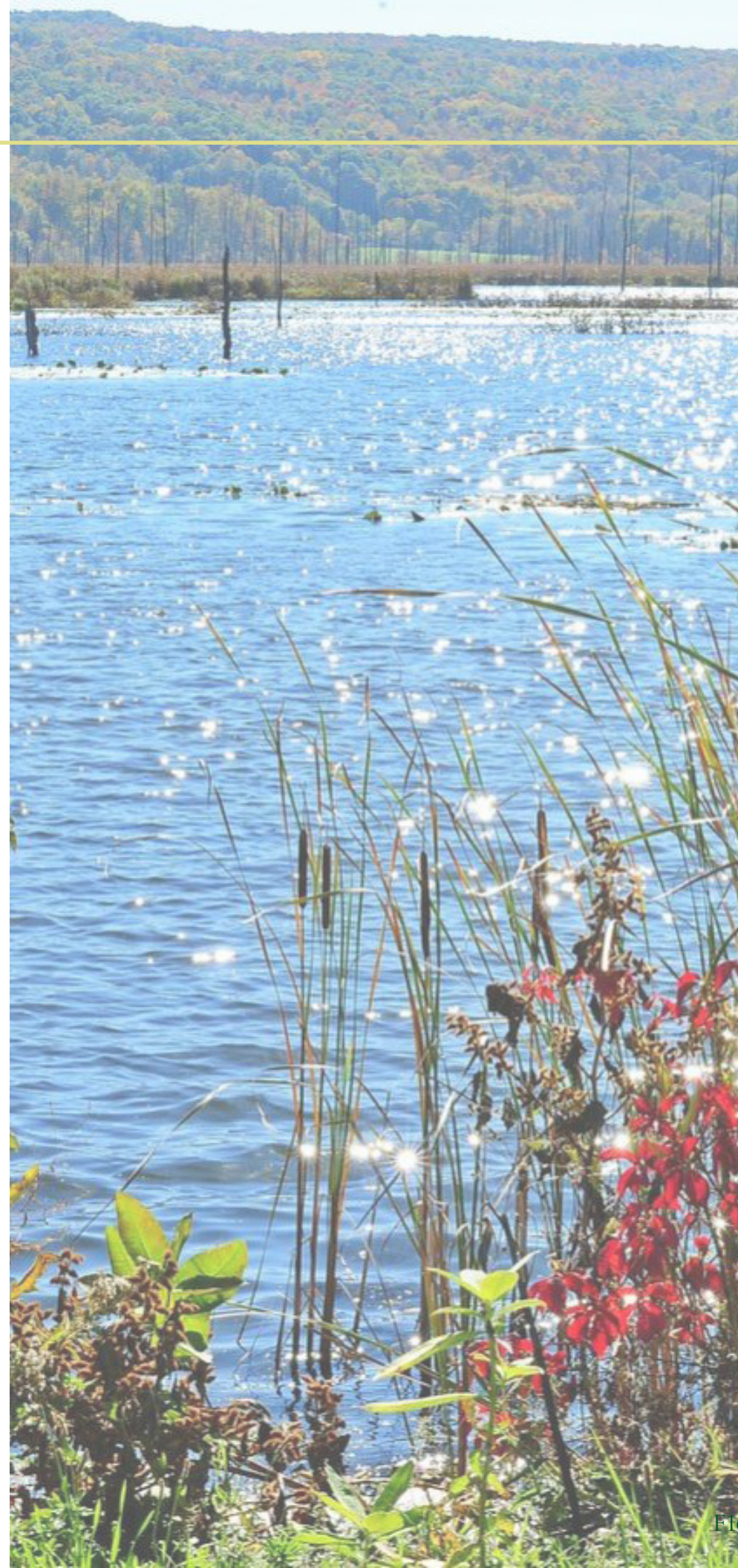
Topics Covered

- 1) Water Planning
- 2) Wetland Conservation Act (WCA) Administration
- 3) Storm water and Shoreline Projects

Review

Introduction

This article identifies how to best protect and enhance Crow Wing County's water resources and the people living in the watershed areas. The Crow Wing County Land Services Department is committed to protect and preserve the water resources in their area while helping landowners develop and preserve their property. Their goal is to achieve water management by using strategies to maximize water resources and give recommendations through analysis of the County's waters. Crow Wing County is committed to providing their citizens with management plans to protect their land and... (continued on next page)



Research Results

Introduction (continued)

...water resources, coordinate to maximize the effectiveness of public funding, manage and grow the education of water resources and management, and to identify threats to the surface and groundwater with action plans.

Concerns

There are several priority concerns than the Crow Wing County has in their region. These concerns are stated as the concern of aquatic invasive species, surface water, and groundwater pollution. To reduce the concerns of invasive species contaminated water resources, the county will have to associate themselves with the public more. Meaning there will be consistent watercraft inspections when citizens are entering the water. Lake districts are required to submit annual reports, and most importantly there will have to be better education and outreach to the citizens using the waters.



F17

Surface water will have to be managed through erosion and sediment control. The Crow Wing County required permits that will encourage landowners to implement storm water plans in their design. The importance of this will help construct better shoreline management and better prevent harmful pollutants from yards to runoff into the water. Shoreline buffers and wetland protection are other factors the County is going to be implementing to property owners. Proper land use and development strategies are required from contractors to reduce phosphorus and nitrate leaking into the lakes and rivers. A study shows that from 2012 to 2014, over 33 lbs. of phosphorus was reduced because of better development strategies.

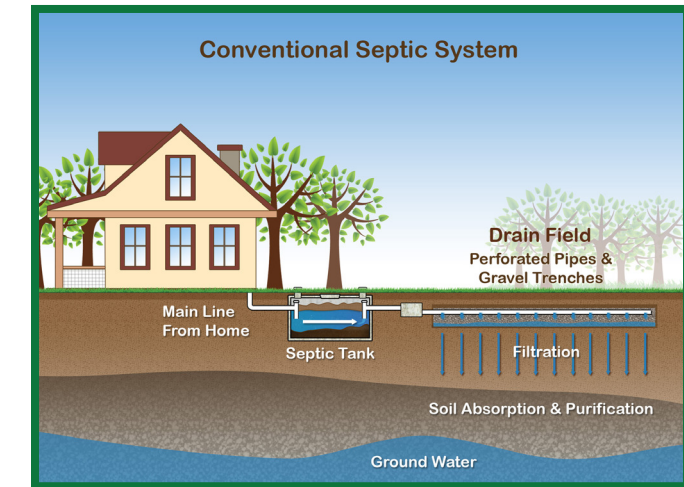


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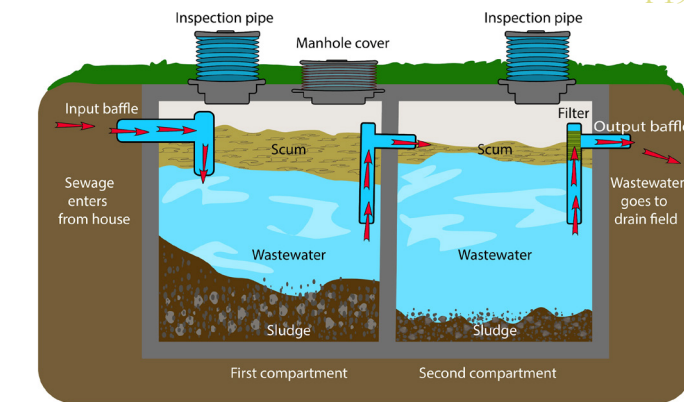
Literature Review

Septic Systems

The right management of septic systems near lakefronts is important to the surrounding wildlife and aquatic habitats. Septic tanks work by allowing waste to separate into three layers: solids, effluent, and scum. The solids settle to the bottom to be decomposed by microorganisms, while the middle layer of effluent exits through underground pipes to be further separated and finally emptied in the drainage field. It is important for homeowners to understand where their septic tank is, and where their drainage field is located for appropriate landscape and hardscape designs.



F19



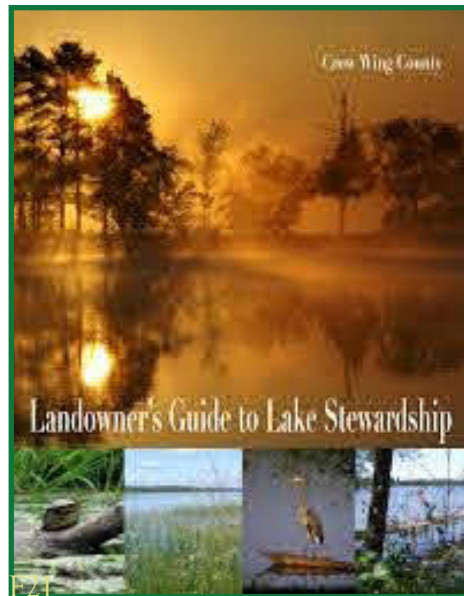
F20

In 2014, Crow Wing County recorded the totals of septic system inspections and installations. 117 of which have a new septic system, 112 have now upgraded their septic system, and 14 landowners had failing systems. There were also 745 inspections done to private and public owners, where 5% of which were non-compliant.

Research Results

Results

Crow Wing County plans to utilize permitting and the reporting of the permits obtained to track storm water implementation and compliance. Phosphorus is tracked by the number of permits, with this analysis calculated, results are that over 80 lbs. of phosphorus was reduced by healthy septic system upgrades and checks. The department is providing the public with a booklet called “Landowner’s Guide to Lake Stewardship” to communicate the simple things so people can help protect their lake.



Surface water will have to be managed through erosion and sediment control. The Crow Wing County required permits that will encourage landowners to implement storm water plans in their design. The importance of this will help construct better shoreline management and better prevent harmful pollutants from yards to runoff into the water. Shoreline buffers and wetland protection are other factors the County is going to be implementing to property owners. Proper land use and development strategies are required from contractors to reduce phosphorus and nitrate leaking into the lakes and rivers. A study shows that from 2012 to 2014, over 33 lbs. of phosphorus was reduced because of better development strategies.



Literature Review

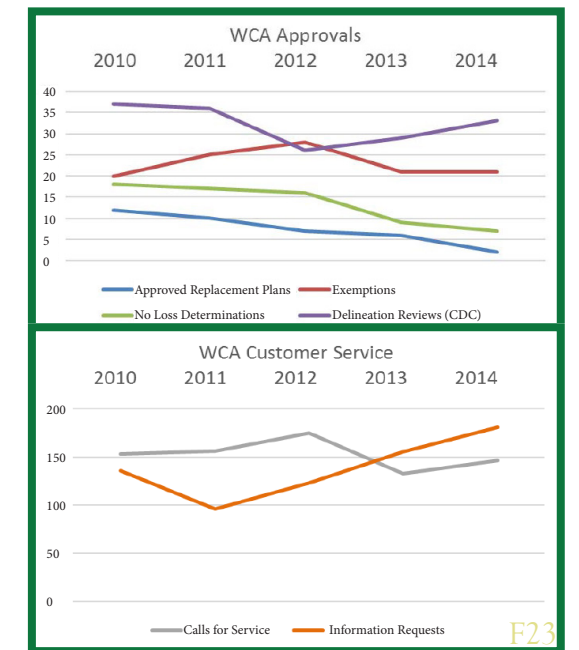
Results (continued)

Crow Wing County administers the WCA and compared its activity over the previous years.

WCA ACTIVITY	2010	2011	2012	2013	2014
Approved Replacement Plans	12	10	7	6	2
Exemptions	20	25	28	21	21
No-Loss Determinations	18	17	16	9	7
Delineation Reviews (CWC)	37	36	26	29	33
No wetland reviews received	N/A	3?	10	10	11
No wetland reviews conducted	N/A	4	5	1	2
Potential Violations	38	29	36	37	33
Calls for Service	153	156	175	133	147
Information Requests	136	96	123	155	181
Violations (Closed, Open)	13.4	13.4	12.7	15.5	5.3

F23

Results conclude that 83% of calls were for service in the Shoreland District, 69% were information requests, and 75% were potential violation reports in this district. There was also a decline in the number of approved replacement plans as well, which is not a good sign for a landowner. There was also no wetland letters received, meaning through the study there is no wetland construction being done, or no reported being done because of the potential violations they could have.



F23

The focus points of these graphs is to show the rarity of an approved replacement plan, and the declining calls for service. These added up predicts that landowners know the probability of an approved design, therefore, they install it without a call for service.

Research Results

Conclusion

From this article, there is no question of how important it is to properly care for homeowner's properties. Without proper care and inspections, there would be an abundance of pollutants contaminating habitats. Most people do not know when their septic systems are due for an upgrade, and before they know it, they have already caused harm to the ecosystem. The county is right to be concerned about the health of the area, and all the concerns they have are within reason. There are dozens of lakefront properties being installed with landscapes and hardscapes in the area, and it is so important for people to be educated on how to rightfully design their yard. Through the surveys and charts shown, it is obvious that there is a rising number of violations and a decreasing number of approved permits. These can be put together in resulting in people not caring about permits because they know every year more and more permits get declined.

Discussion

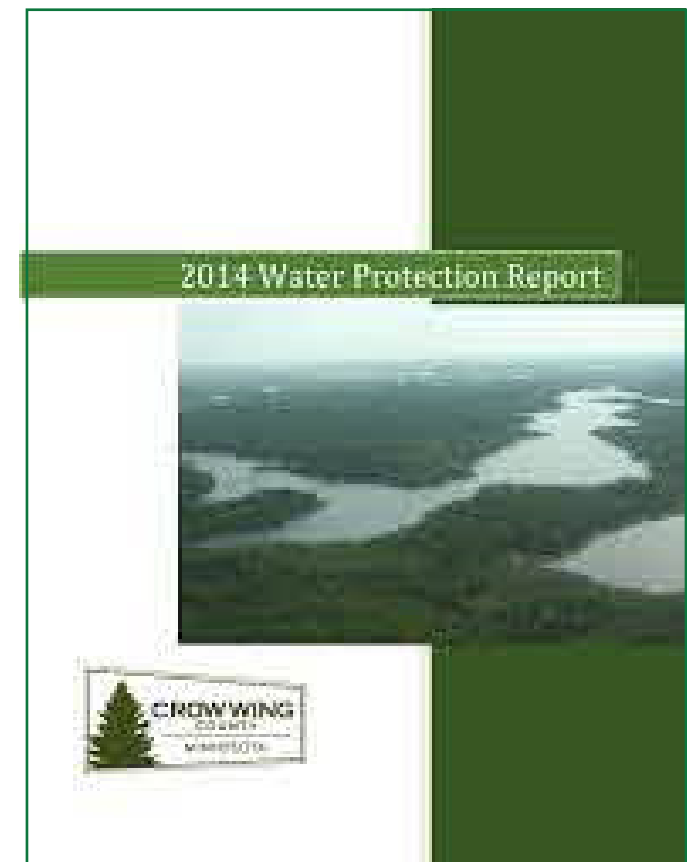
This article is effective in its goal to educate the public about the concerns they have. They do a good job of showing us how permits are being used or not used. Something I think is very important that I can take away from this, even when this article does not even see what the results are showing from a public point of view. That is the results show how irritated the landowners are when it comes to permits and construction. There are more violations reported each year in the area and there must be a stop to this. There are also few wetland permits being reported, and I know this is not because there is no construction being done in wetlands because I have seen it being done without permits. The public needs more from the county, meaning there need to be functional and ecological solutions to what permits are not allowing. Most people know that if they call for a permit and it gets declined, their yard will be watched to make sure they act on the disapproval of the design... (continued on next page)



Literature Review

Discussion (continued)

...Therefore, people do not request permits and construct their yard anyway, resulting in the number of violations each year. My solution to this would be an implemented design strategy that still safe for the environment but gives lake homeowners more freedom in construction. This could result in fewer violations and healthier properties.



Research Results

A Sustainable Landscape Ecosystem Design- Analysis of The New York Academy of Sciences

Lei-Chang Huang, Shu-Hong Ye, Xun Gu Fu-Cun Cao, Zheng-Qiu Fan, Xiang-Rong Wang, Ya-Sheng Wu, and Shou-Bing Wang. Ann. N.Y. Acad. Sci. ISSN 0077-8923

Overview

This article explains the issues of ecological complexity and sustainability. The concern about sustainability between humans and the environment is now a driving motive for this profession. Although, there is a realization that humans are harming the natural environment. Therefore, the concern about sustainability between the environment and humans is what landscape planning is all about for professionals. This article will break down how a sustainable landscape can be economically functional, ecologically sound, and sociocultural useful.

Topics Covered

- 1) Eco-thinking Model
- 2) Sustainability
- 3) Human and Landscape Ecosystem
- 4) Cultural Landscape

Review

Introduction

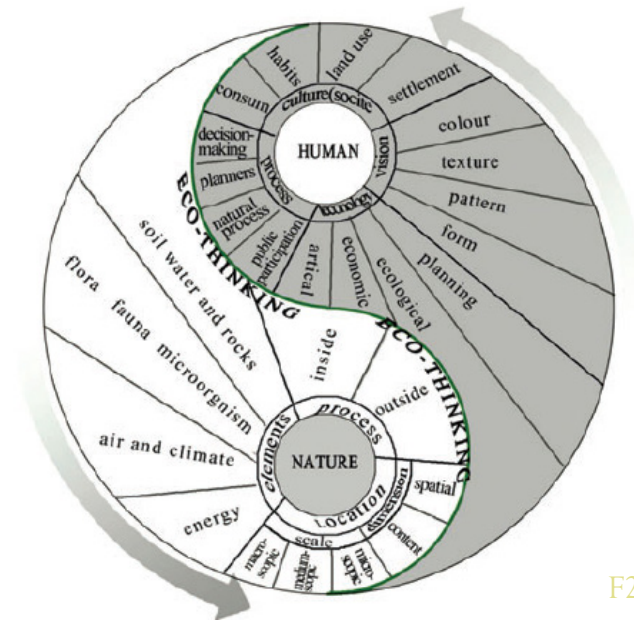
This article talks about how China is exploding with sustainable landscapes which are catching everyone's attention. However, Chinese modern landscape designs have problems of neglecting the sense and natural attributes of a site, taking the design as a simple graphic for a purely functional design. This result is the loss of cultural characteristics, loss of naturalness, and loss of balance between humans and nature. The solution developed for this is the eco thinking model, which is an implemental tool for a sustainable landscape. The objective of eco thinking is a resource-saved and environmentally friendly design, where humans are developing for themselves and nature in one part.



Literature Review

The Eco-thinking Model

One of the most required factors when designing ecologically is to understand and to coordinate between what is required from natural ecosystems and human developments. The eco thinking model consists of visual design enjoyment, the conservation of the environment with development to do the least amount of damage, what the culture is on the site, and the design process of public participation. In relation to this thesis, that would be incorporating the property owners in the design. The development of their land should be based on the protection of the primary environment.



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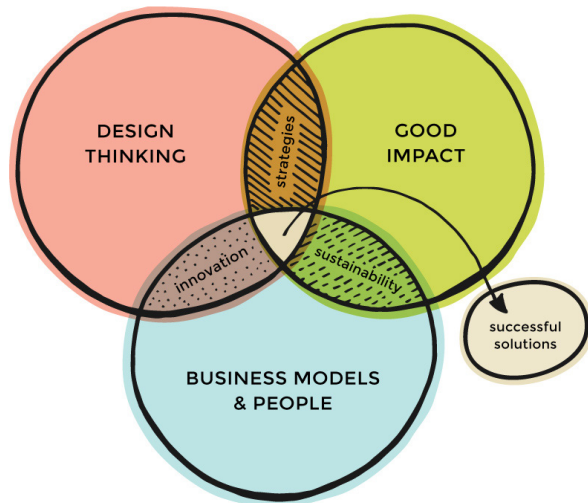
Results

Eco thinking design means to put the concerns of the property owners and the environment there in a single category because they are equally as important. To calculate the results, V=visual design, E=environmental conservation design, C=cultural landscape design, and P=public participation. All these factors added up is a measurable model for a sustainable landscape. V, C, and E are all measured to get the final result. Therefore, the V factors are visual image design, containing local culture, and compatibility design. The E factors are the damage of nature, quantities of the projects, economical cost, and green value. The C factors are the history and custom of the site, and the design idea reflecting the characteristics of the site.

Research Results

Discussion

The contrast of the results tells us that sustainable development is the right way to design, and eco thinking is a necessary method. The factors put into a sustainable design are clearly laid out, and I believe that all the factors are necessary to support the environment. That is an eco-thinking landscape it has the most suitable economic cost and the least amount of damage to nature. Landscapes designed and installed should not only be a visual art for the owners to enjoy but also a space that functions properly in the environment. Laid out in this article, they persuade the readers that the sustainability of a landscape as a goal is yet to be understood enough to achieve it, but rather sustainability should be a direction. I agree with this, seeing that since we are already disturbing nature it is impossible to design with the same sustainability that the site once had. Rather, we should design with the direction of making the site as sustainable as possible with the surrounding environments.



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Literature Review

The Water's Edge

State of Minnesota, Department of Natural Resources, Division of Fisheries, 2009.

Overview

This article discusses the importance of how a lake is managed by property owners. Overdeveloped shorelines can't support the habitats living there. Unfortunately, without people knowing it, that is what they're doing, and the problem is poorly planned lakeshore development. Most people try to develop their lakeshore to get the "clean" look, but unintentionally, this causes green water, more erosion, and nuisance wildlife problems. With a slightly, yet still ecofriendly developed shoreline, there are lots of fish and wildlife, but with over-development there are few fish and wildlife.

Topics Covered

- 1) Shoreline Habitats
- 2) Buffer Strip
- 3) Woody Debris
- 4) Aquatic Vegetation
- 5) Wetlands
- 6) Healthy Lake Development

Review

Introduction

This article focuses on the many ways a property owner can take better care of their lake. It is not a problem when a single person has an overdeveloped lake property, but when everyone on the lake strives for that goal, it affects swimming, fishing, wildlife, and the overall health of the lake. This article is a good guide for lakefront development for homeowners who want to develop their shoreline. Many people who see a natural shoreline think that it could be trashy, but realistically they have the healthiest type of shoreline. Native vegetation, bottom materials, and natural debris play essential roles in the life cycles of the lake's fish and wildlife. Switching from traditional mowed lawns to native grasses and... (continued on next page)

Research Results

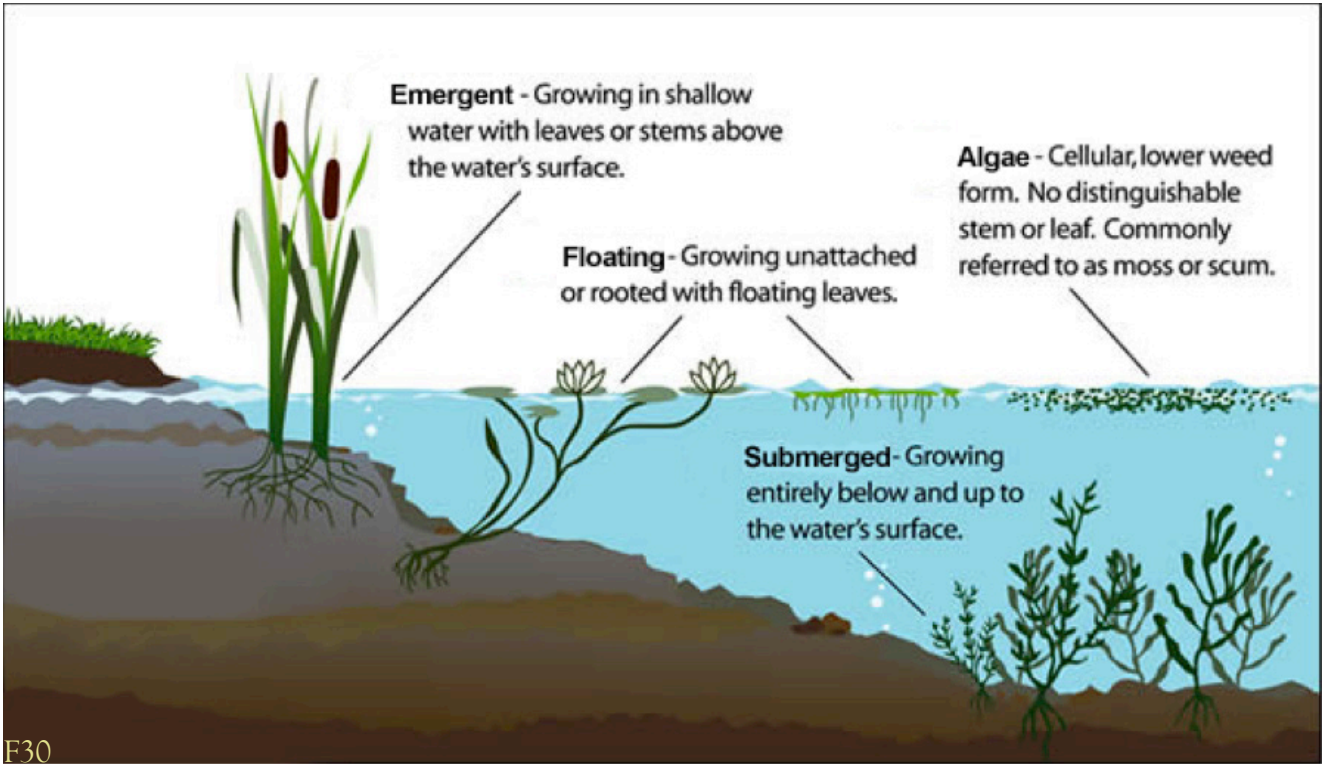
Introduction (continued)

...wildflowers will help wildlife, with little to no maintenance. With the right Landscape Designer, this can be installed to benefit the ecosystem, while giving pleasant views to the property owner.

Aquatic Vegetation and Wetlands

Aquatic plants provide many different organisms while keeping the lakes clean and healthy. Removing this vegetation to improve boating and swimming areas for owners will damage the root network that holds sediments in place. Unknowingly when owners do this, they are letting the waves freely eat away their shoreline.

Wetlands keep the lakes clean by filtering sediments and excess nutrients. These shoreline wetlands are home to a diverse community of plants and wildlife, therefore little to no development can be done in these areas, but some people do anyway and even get away with it. These wetlands have been disrupted by lake owners for boat docks, sheds, and swimming areas



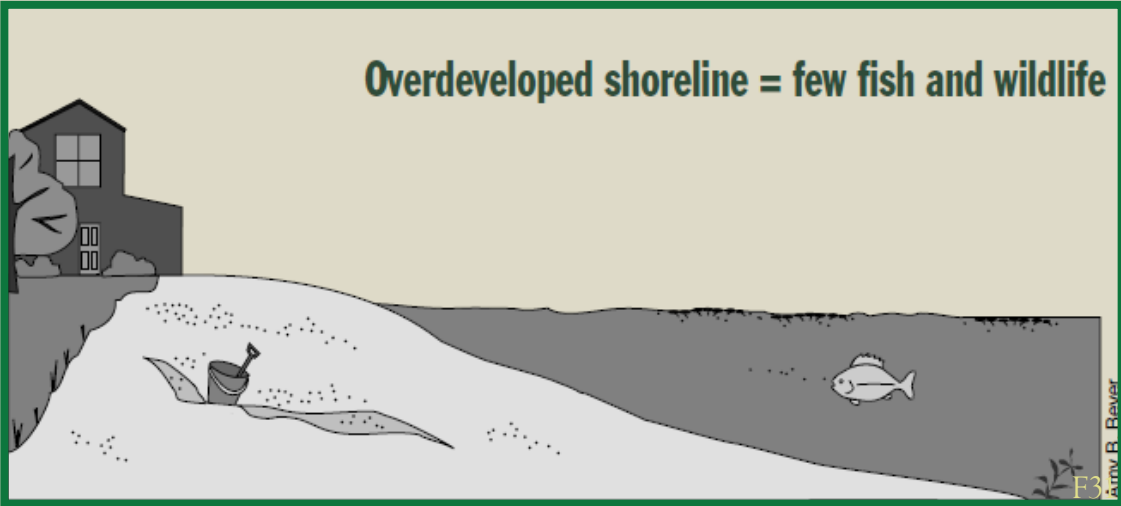
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Literature Review

Result

There is no question about how important it is to keep lakefront properties as natural as possible. People who strive for a “clean” look are removing important plants that will cause erosion, and their mowed lawns carry stormwater runoff into the lake contaminating it with fertilizers, pet waste, and lawn clippings. One of the best solutions to this would be having a buffer strip. On a gentle slope, at least a 30-foot wide strip of natural vegetation between the beach and lawn. This can reduce erosion, help maintain water quality, and provide habitat and travel corridors for wildlife.

Many lakeshore owners consider woody debris and unwanted vegetation unsightly and remove it. Woody debris is important to the lake ecosystem and erosion control. These areas are home to fish and wildlife species who are hiding or feeding in these areas. The government prohibits the removal of these things unless a tree has fallen and is hazardous to navigation or swimming. People who live in the lake’s watershed are responsible for the health of their lake. Pollutants and eroding soil within the entire watershed can easily end up in the lake, therefore it is not just the people who have lakefront properties. A healthy lake is a functioning ecosystem.



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Research Results

Discussion

This article was effective in its goal to the introduce lake homeowners the importance of the natural landscapes on their property. I agree with the fact that if property owners keep trying to get the “clean” look on their property it will result in the inevitable end of the lake’s natural ecosystems. When designers get a lakefront property they should not be trying for a “clean” look. Rather, they should introduce proper design techniques to stabilize their shoreline and the wildlife who need it. I believe that why people want a big green yard that goes right to the lake is because everyone has it. Yes, it does look formal and smooth but unknowingly is dangerous for the lake, and their property. If more designers would design for the environment, I believe that this could introduce a new and better solution for lake properties. If people start to see beautiful designs that still incorporate all the important environmental factors, people will start switching to these types of landscapes.



Literature Review

Lakescaping for wildlife and water quality

Carrol L. Henderson 1998.

Overview

This book is a compilation of proper landscaping techniques for the Minnesota lakeshore, public or private land. Several authors, with master’s degrees in a biology-related field, worked together with the MnDNR to write this book in hopes that it “serves as a catalyst to help change public attitudes about what the ideal lakeshore property should look like” (Henderson, 1998). Other than the authors of his book, some other professionals and colleges were contacted for lakeshore implications such as invasive plant and wildlife control, fisheries, wildlife, proper use of native plants, landscape design, forestry, lawn and garden management, management of beaches, and shoreline erosion control.

Topics Covered

- 1) Lake Ecosystem
- 2) Buffer Zone
- 3) Shoreline Stabilization
- 4) Good Stewardship Practices
- 5) Planting Techniques
- 6) Landscape Design
- 7) Native and Non-native Plants

Review

Introduction

With the progression of lakeshore development, the natural lakeshore has consequently become an endangered habitat. Many property owners want to achieve the “perfect or clean look” which results in a serious loss of natural lakeshore habitat and deteriorating water quality of thousands of lakes to achieve this certain appeal. Even to maintain this look of the property, fertilizers and chemicals then wash into the lakes, causing the growth of algae and pollution of the lake ecosystem. The need for people to realize what they are doing to the lakeshore habitats and ecosystem is greater than ever. (continued on next page)

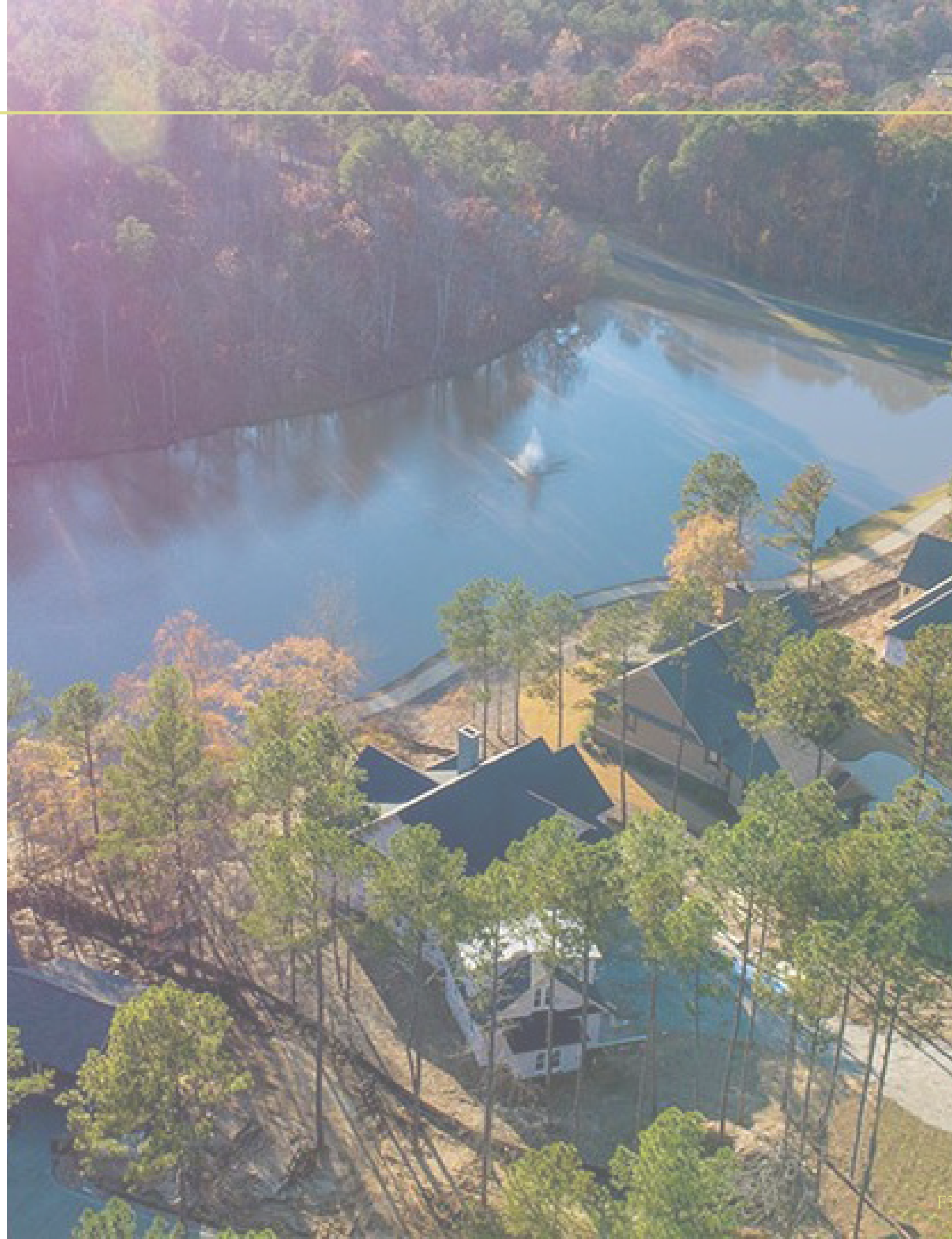
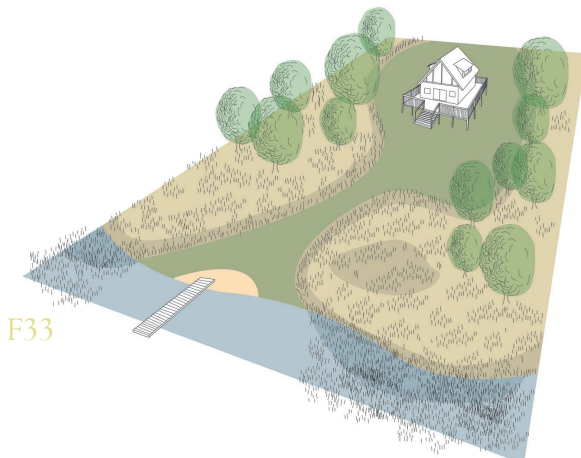
Research Results

Although, with the practices of proper lakeshore management and stewardship, many of the problems caused today can be solved. As designers and the people who maintain our lake's ecosystem, we need to consider the lakeshore is a habitat, not just a property. The more complex and diverse lakeshore properties are, the better they are for the surrounding habitats, ecosystem, and water quality.

Buffer Zone

Many of the problems we see today on lakeshores and be resolved with a buffer zone. This zone should be the main component of landscaping for wildlife and water quality. The buffer zone can restore ecological functions and have other structural benefits such as erosion control, pollution control, and stabilization. To construct this is, three steps are needed to take, first is to identify the improvements needed on the property. The second is to design a natural buffer zone along at least three-fourths of the lake frontage. The third is to restore the native plants in the area as much as possible.

A buffer zone will extend from 25 to 100 feet or more from the water's edge to the upland, and into the lake water 25 to 50 feet. In Minnesota, there is a setback from the water's edge from 25 to 100 feet depending on the county's regulation, which is called the "shore impact zone". The buffer zone should consist of at least 50% to 75% of the shoreland frontage and consist of only native plants. The type of native vegetation used varies on the USDA plant hardiness zone, slope, drainage, and soil type. This zone consists of two components, aquatic plants in the water and moist soil, and upland plants above the waterline. Although, planting in the water will require a permit.



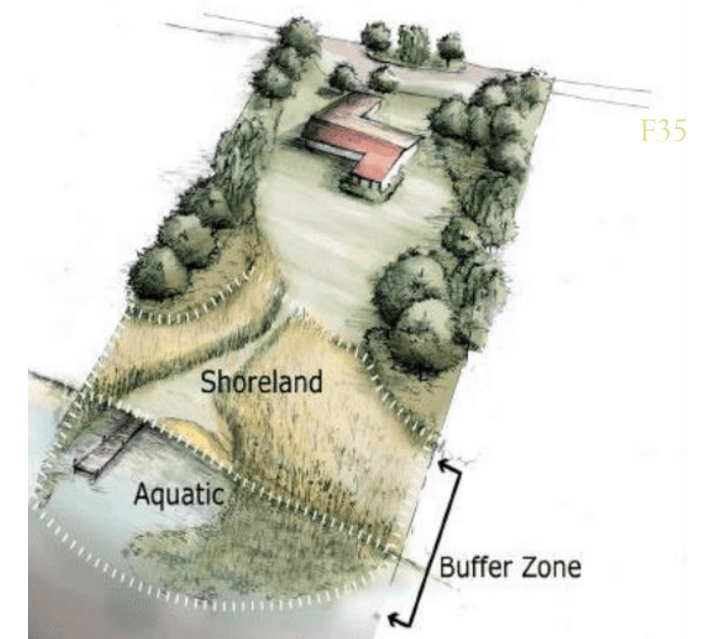
Literature Review

The buffer zone also helps with shoreline erosion because the aquatic plants break down the waves before they hit the shoreline. Although, lakeshore owners who want a large sandy beach will have serious erosion because they have nothing to break down wave impact. The buffer zones plants stabilize the lakeshore and significantly reduce the amount of soil erosion. The buffer zone also traps fertilizers, chemicals, and other potential pollutants from going into the lake water. The buffer zone is the essence of the landscaping concept, which will restore the shoreline with an array of natural beauty such as colors, textures, aromas, and continual wildlife activity.

Designing Lakeshore Landscapes

When designing a lakeshore property, it is essential to think of regional landscapes, the entire lake, and its surroundings. It is important to know the ecological region the property is in to establish correct native plants that thrive in the area. How well the landscape thrives on a property depends on the soils, light conditions, moisture, and slope degree. To understand which plants do best in these areas, it might be best to locate a local botanist.

Consideration of how to meet the desired needs of the property owner and habitats is needed. Examine the site and ask yourself what is the site inventory, utility requirements, recreational requirements, and what can you do to improve the environment and water quality? (continued on next page)



Research Results

A crucial step is to create outdoor spaces that accommodate the activities required. Understand the views that would be needed such as how the windows view the lake, and which lanes to establish for views.

When designing, it is best to imagine what the property would be like before development. Next, think of the space or lawn that is required and carve it out of the imagined vegetation. Creating the walls of the outdoor spaces could simply be groomed by trees and the natural understory vegetation. It is important to retain as much natural vegetation as possible to keep a healthy wildlife habitat, low maintenance, and keep a natural feel. Several planting zones need to be understood, the aquatic and upland buffer zone (both create the buffer zone) and the upland zone. . It is important to remember there are regulations by governing agencies for setbacks and permits may be needed to implement the design.

Results

With the implantation of this book onto our lakeshore landscapes we can establish a healthy lake ecosystem, water quality, and habitat. Minnesota lakes are in danger from bank erosion, nitrogen, and phosphorous loading, and loss of wildlife habitat. Lakeshore owners around the community are responsible for the wellbeing of the lake. The lake benefits or suffers from the actions taken by the community that shares a lake. The destruction of natural vegetation and rivers and lakes are the main cause of the problems of the Minnesota lakes. When natural grasses, aquatic vegetation, and trees are no longer part of the shoreline, the bank experiences erosion problems. Erosion can lead to a loss of water clarity which is integral to underwater plant species used by fish for spawning areas and habitat. Outlined by this book, there are many benefits of a natural shoreline such as native plant communities filter polluted water, protects the shoreline from erosion, and creation of better water quality from aquatic plants.



Literature Review

Discussion

This book is extremely effective in the education of correct lakeshore designing and management techniques for designers and property owners. I agree with the fact that the community in the lake's and river's watershed are responsible for the overall quality of habitat, water quality, and the ecosystem in the area. This article was effective in its goal to introduce lake homeowners to the importance of the natural landscapes on their property. I agree with the fact out lake communities need to depart from the "perfect" or "clean" look of a lawn because all they are doing is ruining the lake community.

What most people do not understand is they can still have a beautiful lake property with the correct landscaping techniques. Once people start to see lawns that are still "perfect" with buffer zones, and other ecological landscaping traits, the movement for this will start to increase. This book also does a good job of explaining different zones, and how to design and install lakeshore properties with all their environmental traits. They also explained permits and setbacks very well for what is required and not required. This book will be used in the plant recommendation portion of this thesis.

Research Results

Research Methods

Plant Analysis and Selection

Lakeshore ecosystems contain a wide variety of plant species and the following will need to be included in the research, evaluation, and selection.

- 1) Trees
- 2) Shrubs
- 3) Grasses & Sedges
- 4) Aquatic Plants

The following characteristics have been selected as useful wildlife and aquatic restoration for lakeshores in Crow Wing County. These plants have been selected for integrating native planting into design to restore ecological functionality, and provide the property with quality plants. Each species is unique and the following traits will all be or not all be included at a time.

- 1) Mature Height & Width
- 2) Hardiness Zone
- 3) Moisture
- 4) Stabilization
- 5) Growth Rate
- 6) Native
- 7) Fall & Winter Interests
- 8) Landscape Value

The table of plants shown on the next page will consist of different large and small trees selected for lakeshore development in the shoreland buffer zone and areas upland. The trees have been selected from multiple sources including Michael Durr's Woody Landscape Manual, MnDNR's Native Plant Encyclopedia, and Landscaping for Wildlife and Water Quality. The tree species shown only consist of native trees to the region. Although, some trees are native to the United States, but not native to Minnesota.



Plant Recommendations

Plant Analysis Table- Trees

Common Name	Scientific Name	Habitat	Mature Height/Width
Balsam Fir	<i>Abies balsamea</i>	Upland Moist	40'-75' x 20'-25'
Red Maple	<i>Acer rubrum</i>	Wet to Upland Moist	40'-60' x 35'-45'
Silver Maple	<i>Acer saccharinum</i>	Wet	75'-100' x 35'-50'
Sugar Maple	<i>Acer saccharum</i>	Upland Moist	60'-75' x 40'-50'
Speckled Alder	<i>Alnus incana ssp. Rugosa</i>	Wet	15'-25' x 15'-25'
Yellow Birch	<i>Betula alleghaniensis</i>	Wet to Upland Moist	60'-75' x 60'-75'
River Birch	<i>Betula nigra</i>	Upland Moist to Dry	40'-50' x 25'-40'
Paper Birch	<i>Betula papyrifera</i>	Upland Moist to Dry	50'-70' x 35'
American Hornbeam	<i>Carpinus caroliniana</i>	Upland Moist	20'-40' x 20'-30'
Hackberry	<i>Celtis occidentalis</i>	Upland Moist	40'-60' x 40'-60'
Pagoda Dogwood	<i>Cornus alternifolia</i>	Upland Dry	15'-20' x 15'-25'
Downy Hawthorn	<i>Crataegus mollis</i>	Upland Dry	20'-40' x 25'-30'
American Beech	<i>Fagus grandifolia</i>	Wet to Upland Moist	50'-70' x 40'
Black Ash	<i>Fraxinus nigra</i>	Wet to Upland Moist	40'-60' x 15'-30'
Green Ash	<i>Fraxinus pennsylvanica</i>	Wet to Upland Dry	50'-60' x 25'
Kentucky Coffetree	<i>Gymnocladus dioicus</i>	Upland Moist	60'-70' x 40'-50'
Eastern Red Cedar	<i>Juniperus virginiana</i>	Upland Dry	40'-50' x 8'-20'
American Larch/Tamarack	<i>Larix laricina</i>	Wet to Upland Moist	40'-80' x 15'-30'
American Hophornbeam	<i>Ostrya virginiana</i>	Upland Moist to Dry	20'-50' x 15'-30'
Black Hills Spruce	<i>Picea glauca 'Densata'</i>	Upland Moist	30'-60' x 15'-25'
Black Spruce	<i>Picea mariana</i>	Wet	30'-60' x 15'-25'
Colorado Spruce	<i>Picea pungens</i>	Upland Moist to Dry	50'-75' x 10'-20'
Jack Pine	<i>Pinus banksiana</i>	Upland Dry	25'-50' x 20'-30'
White Pine	<i>Pinus strobus</i>	Upland Moist to Dry	50'-80' x 20'-40'
Balsam Poplar	<i>Populus balsamifera</i>	Wet to Upland Moist	70'-90' x 25'
Cottonwood	<i>Populus deltoides</i>	Wet to Upland Dry	50'-100' x 40'-75'
Quaking Aspen	<i>Populus tremuloides</i>	Upland Moist to Dry	20'-80' x 20'-30'
American Plum	<i>Prunus americana</i>	Upland Dry	10'-15' x 12'
Common Chokecherry	<i>Prunus virginiana</i>	Upland Moist to Dry	20'-30' x 10'-20'
Northern Pin Oak	<i>Quercus ellipsoidalis</i>	Upland Moist to Dry	60'-70' x 25'-40'
Bur Oak	<i>Quercus macrocarpa</i>	Upland Moist to Dry	70'-80' x 80'
Red Oak	<i>Quercus rubra</i>	Upland Moist to Dry	60'-75' x 45'-75'
Smooth Sumac	<i>Rhus glabra</i>	Upland Moist to Dry	10'-15' x 10'-15'
Pussy Willow	<i>Salix discolor</i>	Wet	15'-25' x 12'-25'

Research Results

Plant Analysis Table- Trees

Common Name	Scientific Name	Habitat	Mature Height/Width
Sandbar Willow	<i>Salix exigua</i>	Shallow Water to Wet	5'-10' x 5'-10'
Black Willow	<i>Salix nigra</i>	Wet	30'-60' x 30'
Northern White Cedar	<i>Thuja occidentalis</i>	Wet to Upland Moist	25'-60' x 10'-12'
Basswood	<i>Tilia americana</i>	Upland Moist	50'-100' x 30'-50'
American Elm	<i>Ulmus americana</i>	Upland Moist to Dry	30'-70' x 30'-60'
Nannyberry	<i>Viburnum angustifolium</i>	Upland Moist	15'-20' x 10'-15'

The table of plants shown above are a continuation of different large and small trees selected for lakeshore development in the shoreland buffer zone and areas upland. The trees have been selected from multiple sources including Michael Dirr's Woody Landscape Manual, MnDNR's Native Plant Encyclopedia, and Landscaping for Wildlife and Water Quality. The tree species shown only consist of native trees to the region. Although, some trees are native to the United States, but not native to Minnesota.



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Plant Recommendations

Plant Analysis Table- Shrubs

Common Name	Scientific Name	Habitat	Mature Height/Width
False Indigo	<i>Amorpha fruticosa</i>	Wet to Upland Moist	4'-12' x 2'-4'
Black Chokeberry	<i>Aronia melanocarpa</i>	Wet to Upland Dry	3'-8' x 3'-6'
Bog Birch	<i>Betula pumila</i>	Wet	5'-8' x 5'-10'
Buttonbush	<i>Cephalanthus occidentalis</i>	Shallow Water to Wet	12' x 12'
Leather-leaf	<i>Chamaedaphne calyculata</i>	Shallow Water to Wet	12' x 12'
Gray Dogwood	<i>Cornus racemosa</i>	Upland Moist to Dry	10'-15' x 10'-15'
Red Osier Dogwood	<i>Cornus sericea</i>	Wet to Upland Dry	5'-9' x 5'-9'
American Hazelnut	<i>Corylus americana</i>	Upland Moist to Dry	15'-18' x 10'-12'
Beaked Hazelnut	<i>Corylus cornuta subsp. Cornuta</i>	Upland Moist to Dry	10' x 10'
Bush Honeysuckle	<i>Diervilla lonicera</i>	Upland Moist to Dry	1'-4' x 2'-4'
Leatherwood	<i>Dirca palustris</i>	Upland Moist	5'-8' x 4'-8'
Winterberry	<i>Ilex verticillata</i>	Wet to Upland Moist	3'-15' x 3'-15'
Old Field Juniper	<i>Juniperus communis var. depressa</i>	Upland Dry	2'-6' x 3'-4'
Creeping Juniper	<i>Juniperus horizontalis</i>	Upland Dry	1.5' x 10'
Labrador Tea	<i>Ledum groenlandicum</i>	Wet	1'-4' x 3'-4'
Ninebark	<i>Physocarpus opulifolius</i>	Upland Dry	6'-10' x 6'-10'
Black Currant	<i>Ribes americanum</i>	Upland Moist	5'-6' x 5'-6'
Black Raspberry	<i>Rubus occidentalis</i>	Upland Moist	3'-5' x 3'-5'
Red Raspberry	<i>Rubus idaeus subsp. Strigosus</i>	Upland Moist to Dry	4'-8' x 3'-5'
Common Elderberry	<i>Sambucus canadensis</i>	Wet to Upland Moist	6'-10' x 6'-12'
Red-berried Elder	<i>Sambucus pubens</i>	Upland Moist	8'-10' x 4'-6'
Meadowsweet	<i>Spiraea alba</i>	Shallow Water to Wet	2'-5' x 2'-4'
Snowberry	<i>Symphoricarpos albus</i>	Upland Dry	3'-6' x 4'-6'
Western Snowberry	<i>Symphoricarpos occidentalis</i>	Upland Dry	5'-6' x 5'-6'
Canada Yew	<i>Taxus canadensis</i>	Upland Dry	3'-5' x 6'-8'
Lowbush Blueberry	<i>Vaccinium angustifolium</i>	Upland Moist to Dry	2' x 2'
Downy Arrowwood	<i>Viburnum rafinespauinum</i>	Upland Moist to Dry	5'-8' x 5'-8'
High-bush Cranberry	<i>Viburnum trilobum</i>	Wet to Upland Moist	8'-15' x 8'-10'

The table shown above are different shrubs selected for lakeshore development in the shoreland buffer zone and areas upland. The shrubs have been selected from multiple sources including Michael Dirr's Woody Landscape Manual, MnDNR's Native Plant Encyclopedia, and Landscaping for Wildlife and Water Quality.

Plant Recommendations

Plant Analysis Table- Grasses, Sedges, and Rushes

Common Name	Scientific Name	Habitat	Mature Height/Width
Big Bluestem	<i>Andropogon gerardii</i>	Upland Moist and Dry	6' x 3'
Blue Grama	<i>Bouteloua gracilis</i>	Upland Moist and Dry	1.25' x 2'
Feather Reed Grass	<i>Calamagrostis acutifolia</i> 'Karl Foerster'	Upland Moist	3' x 2'
Crested Sedge	<i>Carex cristatella</i>	Wet to Upland Moist	3' x 2'
Eastern Star Sedge	<i>Carex radiata</i>	Wet to Upland Moist	1.5' x 1.5'
Awl Fruited Sedge	<i>Carex stipata</i>	Wet	2.5' x 2.5'
Horsetail	<i>Equisetum fluviatile</i>	Deep Water to Wet	3' x 3'
Long-styled Rush	<i>Juncus longistylis</i>	Wet	2' x 2'
Knotted Rush	<i>Juncus nodosus</i>	Shallow Water to Wet	1.5' x 1.5'
Flame Grass	<i>Miscanthus sinensis</i> 'Purpurescens'	Upland Moist	3' x 3'
Silver Feather Grass	<i>Miscanthus sinensis</i> 'Silberfeder'	Upland Moist	6' x 6'
Pickerelweed	<i>Pontederia cordata</i>	Shallow Water to Wet	4' x 4'
Prairie Cordgrass	<i>Spartina pectinata</i>	Shallow Water to Upland Moist	5' x 5'
Prairie Drop Seed	<i>Sporobolus heterolepis</i>	Upland Moist to Dry	2' x 2'

The table of plants shown above are different grasses, sedges, and rushes selected for lakeshore development in the shoreland buffer zone and areas upland. The plants have been selected from multiple sources including Michael Dirr's Woody Landscape Manual, MnDNR's Native Plant Encyclopedia, and Landscaping for Wildlife and Water Quality. Plant Encyclopedia, and Landscaping for Wildlife and Water Quality.

All plant graphs shown above and in the previous pages are cultivar varied, meaning there are different sizes, colors, and habitat conditions for most plants shown above. Therefore, if a client enjoys one of the plants shown above or in the previous pages but something about it does not fit or can properly survive in an area, there may be a different cultivar for that species to fulfill the clients liking.

All of the data above will be processed during the analysis phase of the design process. This will take place next spring during the LA 772 seminar, where additional species types may be implied.



Research Results

Combined Overview

Through the combines research of all the literature reviews, all of which will contribute to the making and conclusion of this thesis project. They have all been proved useful to help guide this thesis into what a healthy lakeshore design consists of, insight of habitat restoration, how to design with current legislation, important usefulness of shoreline erosion and restoration, and an insight into the plant communities in the area.

Plant Recommendation Overview

Through to plant analysis research studied in the past literature reviews and the compiled information of recommended plants for Crow Wing County lakeshores, it will be useful to have a wide range of plant material to be used on the thesis site. The end result in this research gives the community a variety of 14 to 40 different plant varieties for trees, shrubs, grasses, sedges and rushes for lakeshore development. More plant varieties and species will be added in through the LA 772 spring semester.

During the analysis segment of next spring semester the data used in this planting recommendation research will be used to create a complex planting community for a healthy lakeshore development project and lakeshore restoration in the thesis site. The additional plant categories and species will be added into the analysis for the final thesis design.

Continued Research

Further research into setbacks, guidelines propositions, and site analysis will be added through the LA 772 spring semester, as this studio will help influence the analysis and design of this thesis project.

Summary

Summary

The articles discussed in the literature reviews are all relevant and useful for this thesis project. They all give useful information about shoreline development in all factors. They supply this thesis with the proper information to implement designs with proper lakeshore development and all their project elements with lake related development.

In the report "2014 Water Protection Report", it discussed many important element such as water planning, information about the WCA, and stormwater and shoreline project information that are all useful. This report gives important information regarding harmful factors in the ecosystem and how to solve them. Another factor of this report that I believe is useful is the surveys that can lead to the conclusion that every year people no longer care to get government approval for their design because they are fed up with how little they can do to specific properties.

In the article "A Sustainable Landscape Ecosystem Design", it explains the importance of eco-thinking is for sustainable development. This article is important for this thesis to explain why a sustainable design contributes to the overall health of the finished work. Designers should design with the direction of making a site sustainable with its surrounding environment.

In the article "The Water's Edge", it is effective to inform lakeshore property owners about the importance of no longer having a "clean" looking lakefront, but rather introduce designs that restore that natural habitat. This article is perfect for people to visualize what an eco-friendly design may bring to their yard. If lakeshore owners would do this, it would restore many of our lakes today.

Lastly, in the book "Landscaping for wildlife and water quality", it describes what a buffer zone is, and of landscaping and landowner practices such as shoreline erosion, good stewardship, planting techniques, landscape designs, and native and non-native plants. This book is valuable for designers, installers and land owners for important landscape designs that better the lakes ecosystem, and control lakeshore properties to make them last longer, and give them more value. I would recommend this book to anyone dealing with a lakeshore property, or anyone who lives in the lakes water basin.

Overall, the current extent of this research has proved useful for a strong program for the thesis project as I transition into the design studio next spring. This information has helped guide myself for what an ideal lakefront should consist of, and the proper plant communities that should consist in it. Future information of case studies will be included next in this research document.





Before - asphalt landing to lake edge

Project Typology

- 1) Lakeshore Restoration
- 2) Habitat Restoration Techniques
- 3) Erosion Control
- 4) Water Conservation

Context

The lakeshore restoration project is located on Found Lake, a residential based district near the Northern Highland State Forest, in the northern area of Wisconsin. Found Lake is approximately 336 acres, with a maximum depth of 21 feet, with the low water clarity. Visitors have access to the lake from a public boat landing. People who fish in the lake can find Musky, Pan fish Bass, Pike, and Walleye. Found Lake has multiple resorts and campgrounds with a few lakeside restaurants that all attract many people who live on and off the lake. The bottom composites of this lake primarily consist of sand, which is a factor in why the water clarity is poor. Although, the primary source of low water clarity is caused by human interaction in most lakes.

History

In 2007, the Wisconsin Department of Natural Resources (WDNR) initiated a long-term study to quantify the ecological benefits of lakeshore restoration on lakes with shorelines significantly altered by houses and resorts being developed. Known as the Wisconsin Lakeshore Restoration Project (WLRP), this project investigates the endeavors to enhance natural habitats on 5 developed lakes, Found Lakes being one.

Lakeside properties on Found Lake were struggling with trying to stabilize their shorelines and reduce runoff into the lake, which contributed to the low water clarity. This case study shows how the community and district went about solving and restoring their lakeside properties. This project used bioengineering and habitat restoration techniques to restore their shores. The community made sure to keep the design as ecological as possible by using native plantings and other restoration and erosion techniques. The goal of the project is to establish lakeshore restoration projects on private and public properties .



After - asphalt landing removed, straw matting and turf matting installed with native plantings

Then assess whether wildlife habitat structure, wildlife populations, and native plant diversity increase on restored lakeshores and whether the restored habitat is becoming more like that found on paired, undeveloped lakes.

Contribution to Thesis

This case study shows an example of how to properly develop lakeside properties. This project reveals how harmful lakeside development is to the environment and shows proper techniques on how to restore lakeshore habitats. The techniques used to restore their habitats is a foundation for other restoration projects that will need to be done for this thesis.

One of the factors they used in the (WLRP) is using native plantings. The natural plants used will grow with low maintenance, while the buffer zone plantings will reduce the velocity of runoff and filter sediments. They also used coconut fiber logs and straw mattings for erosion control. They also utilized the importance of rain gardens for runoff collection and filtration. The use of these techniques will enhance the health, and scenic beauty of the lake community, all-important for this thesis's design

Project Elements

- 1) Bioengineering
- 2) Native Plantings
- 3) Soil Erosion Products
- 4) Rain Gardens

Conclusion

The (WLRP) knew the importance of having healthy habitats and was successful in contributing to and enforcing the proper techniques of lakeshore designs. They restored aquatic and wildlife habitats with natural designs that also reduced stormwater runoff velocity that will help with fewer pollutants washing into the lake.

With the proper shoreline techniques used the amount of shoreline erosion will be substantially reduced making for healthier habitats, and economic value to lakeshore properties. This project has a positive economic impact that will attract more tourism and will shore the community what a healthy shoreline will bring



Project Typology

- 1) Habitat Restoration
- 2) Sediment Restoration
- 3) Wildlife Permits

Context

This remediation and restoration project is located on Mirror Lake, Dover, Delaware. Mirror Lake is approximately 3.5 acres, and 3 feet deep, with it being a part of the Saint Jones watershed that will eventually empty into Delaware Bay. The lake is nearby many commercial properties that have large parking lots which will contribute to the overall pollution of the lake. This lake contains many harmful chemicals such as PCBs, dioxins & furans, OC pesticides, mercury, and PAHs that contribute to struggling ecological diversity and functionality.

History

Fish advisories have existed in this area since 1988 due to the lake's lack in ecology, and environmental functionality. To restore the watershed quality, the Delaware Department of Natural Resources and Environmental

Control (DNREC) initiated the restoration of Mirror Lake. Mirror Lake has suffered from stormwater runoff, increased nutrient loading, and chemical contaminants from within the watershed that eventually settles to the bottom of the lake until the net storm stirs it up again.

This project took place in 2013 by the DNREC and several other partners. The goal of this project was to remediate the sediments to make a healthy food chain, restore the habitat, and improve the visual appeal of the lake. The permits required for this project took about a year to get from multiple permitting agencies. The permits and agreements required for this project were DNDEC Subaqueous Lands Permit, DNREC Erosion, and Sediment Control Permit, the NWP 27 and 38 permits from the US Army Corps of Engineers Nationwide, and Access Agreements from property owners.

The cost of this project was a total of \$0.94 million, but labor was mostly volunteering from multiple companies and agencies. Steps used to complete their goal were to add a pellet made up of activated carbon, sand, and clay that will lay at the bottom of the lake that will hold contaminants so they no longer harm the organisms living in the lake.



The landscaping outside the lake was designed by Bio habitats, and they designed a tidal wetland planting that will improve the area's habitat, and water quality of the lake.

Contribution to Thesis

This case study shows an appropriate example of how important water quality is to the food chain. This study also demonstrates how long it takes to get a project started by how many permits are required for a project. Most people do not understand how important it is to design a lakeshore property with the intent to have an ecological landscape. Without such a design, it is harmful to wildlife, aquatic habitats, and eventually the food chain.

This project demonstrates an appropriate measure from the beginning of a lakeshore design to the end. The beginning of the project has to do with incorrect and harmful lakeshore designs, so therefore a restoration project is needed. To get that project started, there had to be over a year of required permits to get started. Conclusion that when the project is done, the overall quality of the lake is better, and better for the surrounding environment.

Project Elements

- 1) Chemical Contamination
- 2) Permits
- 3) Bioaccumulation
- 4) Fish Tissue Health
- 5) Wetland Planning

Conclusion

After years of permits, agreements, and construction the DNREC and other partners have finally restored Mirror Lake to a healthier ecosystem. The results of this project after one year were about a 60% decrease in water pollution, and PCB in resident fish species. This project will be monitoring the lake for several more years. The project elements used restored the overall health of the lake, and the environment around it. They also restored the native vegetation that will provide additional habitats for the species to thrive in amongst the wetland vegetation. It should be a goal as designers to see the importance of healthy lake vegetation, and water quality designs.



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Project Typology

- 1) Residential Lakeshore Design
- 2) Social Choreography
- 3) Ecology

Context

This lakeshore project is a south-west facing property about the size of an acre on the suburban shores of Lake Washington, Seattle. Most of this lake is occupied by intensively managed lawns that inevitably harm the lake's ecology and riparian habitat. This lakefront property has 150 feet of shoreline, unfortunately, because it was built in the 60s it is a failed attempt to create a healthy shoreline from wave impact.

History

The main goal of this project was to create better connections between people and nature. The mission manipulated landforms, plant-life, and social choreography to show mindful transitions from space to space for property owners to enjoy nature.

To complete this project, there must be ecological improvements to the physical land, shoreline habitat, and water quality.

This project uses their design to redefine the residential experience to where the landscape is now perceived as a habitat that is used by humans and animals. To solve the site's runoff problem, the designer changed the grade to create a diverse topography with interlinked foreground, middle-ground, and background. Another factor to this project was extending visual interest throughout the seasons, this was done by native and non-native planting. Importantly, the native planting was near the shoreline.

This project faced other problems that had to do with government permits and changing local jurisdiction halfway through. This resulted in long delays and forced the design team to have to redesign for the required design requirements. Although, with the attracted government on this project, the Green Shores and Homes (GSH) used this finished project as a laboratory to fine-tune their program.



Contribution to Thesis

This case study shows ideal design parameters and problems that are faced with lakeshore designs. I believe these project designs were well thought out to create an ecological landscape design that favors nature, while also adding and connecting spaces to add to the client's enjoyment and sense of place.

Designing on lakeshores should be well planned out not only to create spaces for humans, but the integration of nature in those spaces is what we should strive for in designs. As the community of lakeshore owners evolves, it is important to create designs that show linked spaces and scenes for human pleasure but have that in nature. Doing so will better the ecology of the site and the overall health of the community.

Project Elements

- 1) Native and Non-native Vegetation
- 2) Natural Landscape Features
- 3) Boat House
- 4) Terrace
- 5) Circulation
- 6) Government Jurisdiction

Conclusion

A Shoreline Re-Imaged design and installation shows an excellent example of some of the best types of landscape designs for residential lakeshore properties. With the rise in urbanism, the need for connections to nature will only grow. This project also shows a great example of how to design built and unbuilt project elements to show designers how to re-engage with nature's rhythms. Well said in this case study is that a sustainable landscape is a connected one. Our environment is on the verge of substantial healing with ecological improvements to the physical process, water quality, and shoreline habitat shown in this case study.

Project Justification

Overview

When designing and installing on lakeside properties it is a dominant factor to follow the State and County's regulations. Even though they give properties regulations it is still important for the safety of the environment, and the properties foundation. With modern technologies, ensuring the safety of the ecosystems is easier than ever in designs with rain-gardens permeable materials, and more.

When a contractor is designing for a lakeside property, a part of this is likely a wetland or bluff. Many people do not realize the importance of the regulations and why they are established, but with so many rules, people do not seem to care, which could be harmful to wildlife habitats, their foundation, or they could be contacted by law enforcement and will face the penalties. This project will clearly show what can and can not be done in Crow Wing County but can be implemented for the state of Minnesota because this county consists of many bluffs, wetlands, and people who do not understand the importance of wildlife regulations.

As modern technologies advance it is important for past laws are regulations to see the potential of these advances and reform from what is already set in stone. Residential and commercial lakeside properties are always designing and installing with the newest and best features. Most of these elements are developed with the idea of making stable and environmentally friendly factors. This study will also improve present regulations for more up to date laws that keep wildlife habitats safe.

Personal Relevance

This project defined is important to myself and all professionals working in this area. I've lived in Crow Wing County most of my life, therefore I have insight to the potential of designs that follow lakeside regulations have, and what designs bring to a landscape if they do not follow these regulations.

I've installed and helped with designs for countless lakeshore residential properties that follow all these regulations.

What needs to be brought to attention is that most projects I've done, are to restore past failed projects that have been installed incorrectly, or installed before the present regulations have been made. As a future Landscape Architect, I need to use and fully understand the research done in this thesis as a foundation for clients to use when designing future projects, failure to use my understanding could result in many unpleasant consequences.

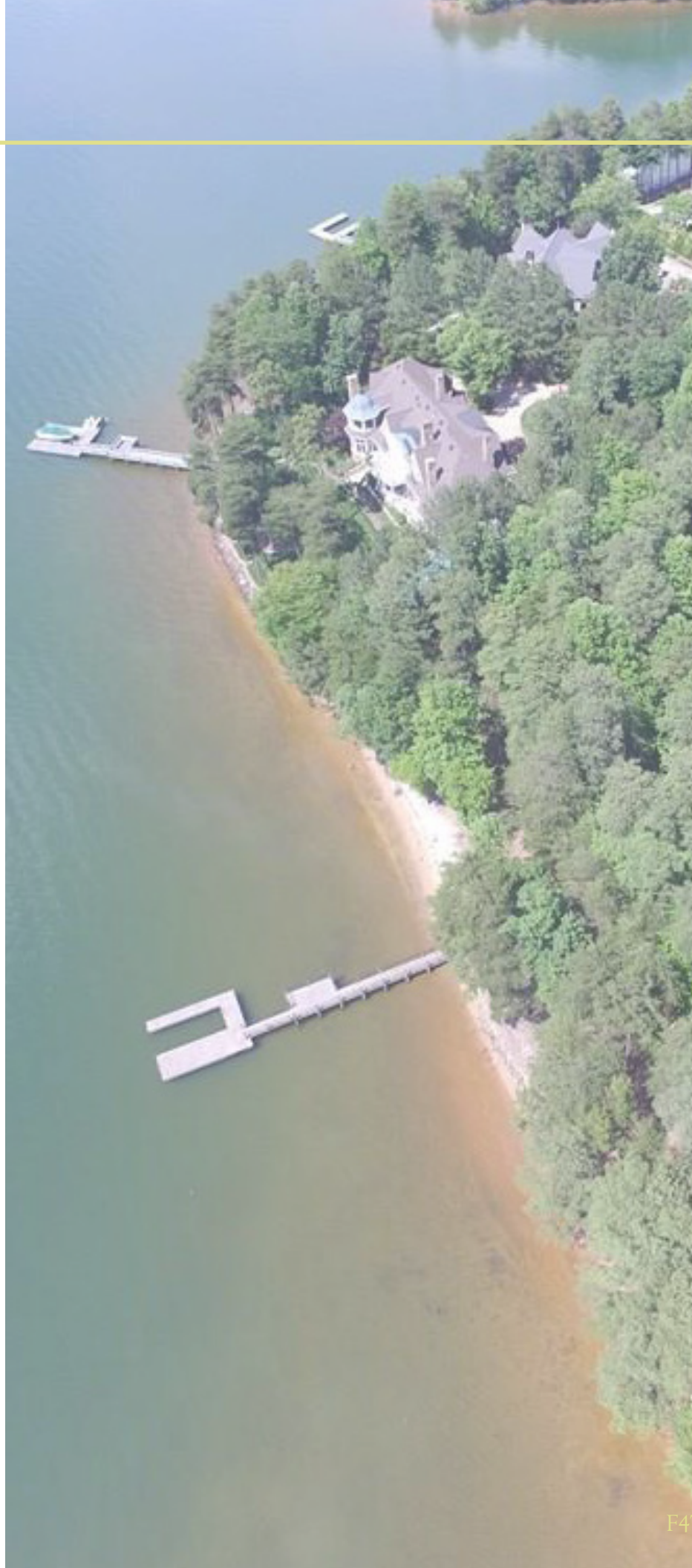
Professional Relevance

As any Landscape Architect in the profession knows, the importance of designing with and not against wildlife and ecosystems is a must in maintaining the natural order between mankind and the nature we live in. This project is important for the designers in this study because I feel like they also know that with modern technologies, some improvements could be added to the present legislation.

Furthermore, the environmental impacts of designers impact the relationship between landscape planning and sustainable development. Without knowledge of eco-friendly designs, there can be an unsustainable use of landscape elements that could lead to many of the environmental problems that consist of lakeshore designs.

Social Relevance

Not only can following the guidelines and future implementation of regulations can help make eco-friendly designs, but it will please clients and landowners even more. Most lake owners want one thing with their property, and that is to use and design as much of their property as possible. Unfortunately for people who live on a bluff or wetland, they have been left frustrated with the limitations of their owned land.



Project Justification

This project will implement new designs that go beyond the regulations but will still follow every environmental safety reason there is to provide the community with new and better designs for their property. This will change the way landscapes are designed in the area, providing landowners with more economic value on their land while keeping our wildlife habitats safe.

Project Financing

The scope of this project is the state of what can and can not be designed and installed on lakeshore properties due to wildlife factors. Most people who own lakeshore properties will spend a lot of money to design as much of their property as possible. Therefore, contractors who understand correct lakeshore design can provide clients with the best types of designs that remain eco-friendly.

Although, what I am proposing is the make new legislation that is one jurisdiction or one regulatory agency that covers all building permits and construction. Funding for this will be expected by the present government agencies and will be maintained on just one website for contractors to contact. This is related to social relevance because it makes new projects for contractors and designers to get started much faster, therefore making more time for future projects, and more income for their companies.

Project Impacts

Wing County will have the option to load this thesis project for a re-imagined design for lakeshore properties. In the area, contractors and installers can also use this for correct guidelines, setbacks, and restrictions for lakeshore properties.

The purpose of this project is to positively impact the lakeshore properties in Crow Wing county to provide them with new alternatives for lakeshore design. This thesis project will help guide the community for proper development techniques that will benefit themselves, and the nature around them.

Laws & Regulations

Overview

This segment of the thesis will include all of the setbacks and guidelines for Crow Wing County. The use of these are regulated and enforced by state and local jurisdiction. It is important to understand that the state of Minnesota's regulation of lakeshore design is an overall implementation of all the counties in the state. Each county however, has more precise regulations and setbacks, therefore this is not an accurate analysis of county's other than Crow Wing County. This research will include approximately 731,000 surface acres, and 14% or approximately 102,000 acres, are covered by scenic lakes, rivers, and streams. An additional 14% of the County is covered by wetlands. A shoreland alteration permit is required for most dirt moving and vegetation removal activities in shoreland zones (within 1,000 feet for lakes, and 300 feet for streams).

Who Has Permit Authority?

The knowledge of where to get permits and who has the authority to give permits is important to know for doing lakeshore designs. Without contacting one of all of these agencies, a lakeshore design may not be approved, or illegal to install and work that affects lakes, rivers, streams, and wetlands. These agencies include the Federal (Section 404 Army Corps of Engineers), state (Minnesota DNR Public Works Program), and local authorities (Crow Wing County Soil and Water Conservation District, Crow Wing County, City of Pequot Lakes or City of Brainerd). If someone does not know if they are in a restricted area, they can contact and get assistance from the SWCD.



State Regulations

Permit Requirements in the State of Minnesota in Public Waters and Wetlands (Most Common)

- I) Permitted areas still have to follow State and County guidelines
- II) Permit Required areas have to go through the State and County
- III) Restricted areas there is nothing allowed, if done otherwise there will be a fine and the DNR can still remove what has been constructed

Design Types	Permitted	Permit Required	Restricted
Beach Sand Blanket	✓		
Blastings			✗
Bluffs		✓	
Boat House & Storage		✓	
Bridge Crossing		✓	
Fill		✓	
Irrigation Pump from Lake (Under 10,000 gal per day)	✓		
Planting Prohibited Exotic Species			✗
All Work Done Below The OHWT		✓	
Rip-rap		✓	
Lawn Landscaping	✓		
Shore/Aquatic Vegetation Removal		✓	
Shore land Tree Removal (Dead or Alive)			✗
Wildlife Pond or Rain garden	✓		
Ice Ridges		✓	
Sunken Log Removal			✗
Wetland Activity		✓	

	Anticipated Lead Time	Small Structure (Above OHWT)	Impervious Fill	Veg Removal (150' or to the building Setback)	Patio	Retaining Wall	US Army Core Jurisdiction (Reservoirs, International Water Ways)	Land Clearing
Federal (USDA, USACE)	3 Months						Yes	
State (MnDNR)	6 Weeks							
County (Department of Land Development)	2 Weeks	Yes	Yes	Yes	Yes	Yes		Yes
Municipality (Building Department)	2 Weeks	Yes	Yes	Yes	Yes	Yes		Yes

	Rip-Rap	State Owned Land	Boardwalks	Sand Blanket	Dredging	Septic System	Dock Platform over 120sq.ft. (Not including walkway)
Federal (USDA, USACE)							
State (MnDNR)		Yes			Yes		
County (Department of Land Development)	Yes		Yes	Yes	Yes	Yes	Yes
Municipality (Building Department)	Yes		Yes	Yes	Yes	Yes	Yes

Setbacks

State shoreland rules establish minimum setbacks from the ordinary high water level (OHWL) of lakes and rivers, and from the top of bluffs. This section will include the setbacks and other guidelines and regulations for non-wetlands, wetlands, bluffs, shoreland buffer zone, lake beach frontage, patios and retaining walls, and tree and vegetation removal.

Non-Wetland

- 1) Shed or structure is at least 20 ft. from the OHWL (with permit)
- 2) Shed or structure can be 120 sq. ft. but the front has to be behind the setback
- 3) No building restrictions after 75' from the OHWT
- 4) A 4 ft. wide walkway or stairway within the lake setback is allowed with a permit

Wetland

- 1) For structures and hardscapes, 20 sq. ft. is allowed within 20' of OHWT (with permit)
- 2) For structures and hardscapes, 400 sq. ft. is allowed after 75' from OWHT (with permit)
- 3) An 8 ft. wide elevated boardwalk for lake access over wetlands is allowed (with permit)

Note- The development of these will be considered as fill or an impervious surface



Bluffs

- 1) Structures need to be at least 30 ft. back from the top of the bluff
- 2) Bluff impact zone is between the 30 ft. setback from the top of the bluff
- 2) Slopes over 12% of 50 ft. or more is not recommended for development due to steepness and soil characteristics
- 3) Article 11.21 D: Moving dirt in the bluff impact zone is prohibited, except for what is permitted under Article 11.9. Moving dirt on steep slopes may be permitted with stormwater and erosion control plan approved by the department, as well as an approved Shoreland Altercation Permit
- 4) Article 11.20 E: Vegetative buffer is required in the bluff impact zone. Removing of vegetation and ground cover is prohibited, except what is permitted under Article 11.9.
- 5) Article 11.9: Stairways and lifts are allowed in the shore impact zone, and down bluffs and steep slopes. 4 ft. maximum is permitted on residential lots, and 8 ft. maximum is permitted on water-oriented commercial lots. Landings cannot exceed 32 sq. ft. on residential lots (64 sq. ft. for commercial)

Note: Bluffs are located in a shore land area, that the slope rises at least 25 ft. above the toe of the bluff. The grade of the slope from the toe of the bluff to the top of the bluff averages 30% or greater to qualify, as well as the slope has to drain toward the water of body to be considered a bluff.

Laws & Regulations

Shoreland Buffer Zone

- 1) Shore impact zone (SIZ) includes 1,000 ft. from lakes, and 300' from a river or stream
- 2) Buffer zone includes 25 ft. to 50 ft. from shore, but as little as 10 ft. to 15 ft. can restore lake health
- 3) Recommended 75% of vegetative shoreline frontage
- 4) Recreational use of a shoreline must not exceed 30% of the total width and 25 ft. landward from the OHWL
- 5) Maximum width of a shoreline recreation use area shall not exceed 200 ft.
- 6) Wetland habitat improvements can be made with an approved plan
- 7) Total of 30 cubic yards of dirt may be permitted in upland fill in SIZ 1
- 8) No wetland fill shall be allowed except as allowed under MN Rules in SIZ 1 and 2
- 9) Total of 50 cubic yards of dirt may be permitted in upland fill in SIZ 2

Lake Beach Frontage

- 1) Length is limited to 30% of shoreline (200 ft. max)
- 2) Maximum width of 25 ft. back from the OHWL
- 3) Permit required for (< 10% slope)
- 4) Can add a maximum of 10 yards of sand each year

Patios

- 1) Permitted 120 sq. ft. in SIZ1
- 2) Permitted 250 sq. ft. in SIZ2 but can be up to 400 sq. ft. with implemented SW management plan according to Article 41
- 3) Not be 1 ft. below or above the natural ground level

Note- Patios are allowed behind the structure setback without a permit



Crow Wing County

Retaining Walls

In the shoreland impact zone

- 1) Department determines that there is no alternative to erosion control
- 2) No tier of the wall may exceed 4 ft. in height without a Minnesota-licensed professional engineer

Note- A permit is not required if the retaining wall is behind the structure setback if it does not significantly alter the character of the property and does not create runoff or erosion problems.

Tree and Vegetation Removal

- 1) Removal within the shore and bluff zones are not allowed
- 2) limited tree, shrub, pruning, and trimming to accommodate a placement of stairways and beaches are allowed if screening of vegetation is not substantially reduced (for rivers, the shading of water is preserved)
- 3) Restricted use of removing trees, limbs, and dead branches (exception to if they pose a safety hazard)

Note: These rules only consist of the shoreland impact zone, anything upland in permitted with exception to not substantially reducing the habitat

Docks

- 1) Docks with a platform area up to 120 square feet (not including walkway) are allowed
- 2) Docks with a platform area up to 170 square feet (including walkway) are allowed
- 3) The dock leading out to the platform must be 5 feet or less in width and the dock must be on a lake with a shoreland classification of General Development or Recreational Development

Law Improvements

Law Regulation Improvements

The improvements I am proposing are to make construction of lakeshore properties easier for the owners and contractors. The implementation of environmental factors such as habitat, erosion control, native plantings, and others included in this thesis are still being considered, so there are no problems with disturbance of these factors. The only propositions that in being proposed are ones that will still cause no harm to the environment, justified through calculations.

The Minnesota setbacks and guidelines are an overall approximation of the vast amount of different districts. This can be misleading to installers when looking for the MnDNR website page to guide their designs. Each County has their own rules and setback guidelines that vary from the state, and in those counties they can add additional restrictions. When constructing lakeside projects (especially in a wetland or bluff) contacting the many governing agencies for permits can be confusing. If the owner lives in a rural area, they contact the county. Even though, the rules start with the state of Minnesota, then the county, then the city. Each of which have added jurisdiction.

I am proposing one jurisdiction or one regulatory agency that covers all the building and construction permits. With this, there should be one set of rules that cover the entire state, if anything they should make more rules than that cover different soil and moisture classes. There should only be one website for the state of Minnesota for when people look up information regarding their design, they have exactly what they need.

Added Regulations and Setbacks

I am also proposing the consideration of using a raised structure with helical piers in lakeshore designs. These piers thread into the ground, which prevents only a small amount of disturbance. The piers also raise structures above the ground, which will allow stormwater to pass underneath the structure. This results in no disturbance to stormwater runoff, which would not impact shoreline erosion.



Law Improvements

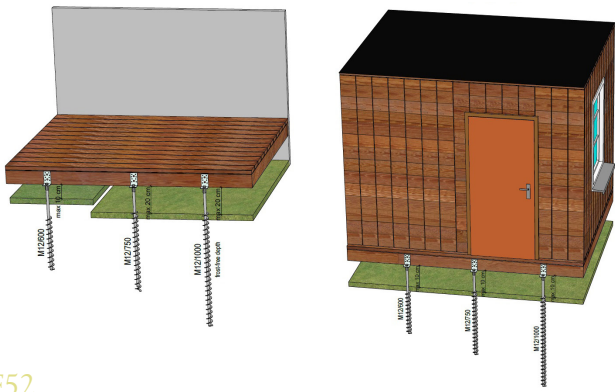
As of now, the helical piers are viewed no different than a solid structure. They have the same rules and setbacks that are required by the state and county without acknowledgment of how environmentally friendly these are. As of now the helical piers are viewed as "fill". I ask, how can they be viewed and something that is filled in with a large gap underneath it to allow stormwater runoff to pass through it?

I would also like to propose that the restriction of only 30% of a lake frontage can be altered per property. I understand why the government restrict this, but they should add to 30% of a shoreline should be open for clearing, and 70% of the lake frontage can be altered for an environmentally friendly replacement design that still benefits the habitat, but is more pleasing to look at for the property owner. In this 70% there should be a proposition for a design to manipulate wetlands, and add simple but yet affective design fractures such as raingarden development. With a raingarden in place, this would allow thicker clearing of vegetation to be removed. This would be okay because the raingarden is protecting the filtration and runoff. Lastly, the construction of a structure with helical piers should be allowed further into these restricted areas. The piers hardly rarely disturb the soil and can be screwed in as deep as they are needed. Structures sitting on this would not be counted as "fill" because it allows the water to run underneath.

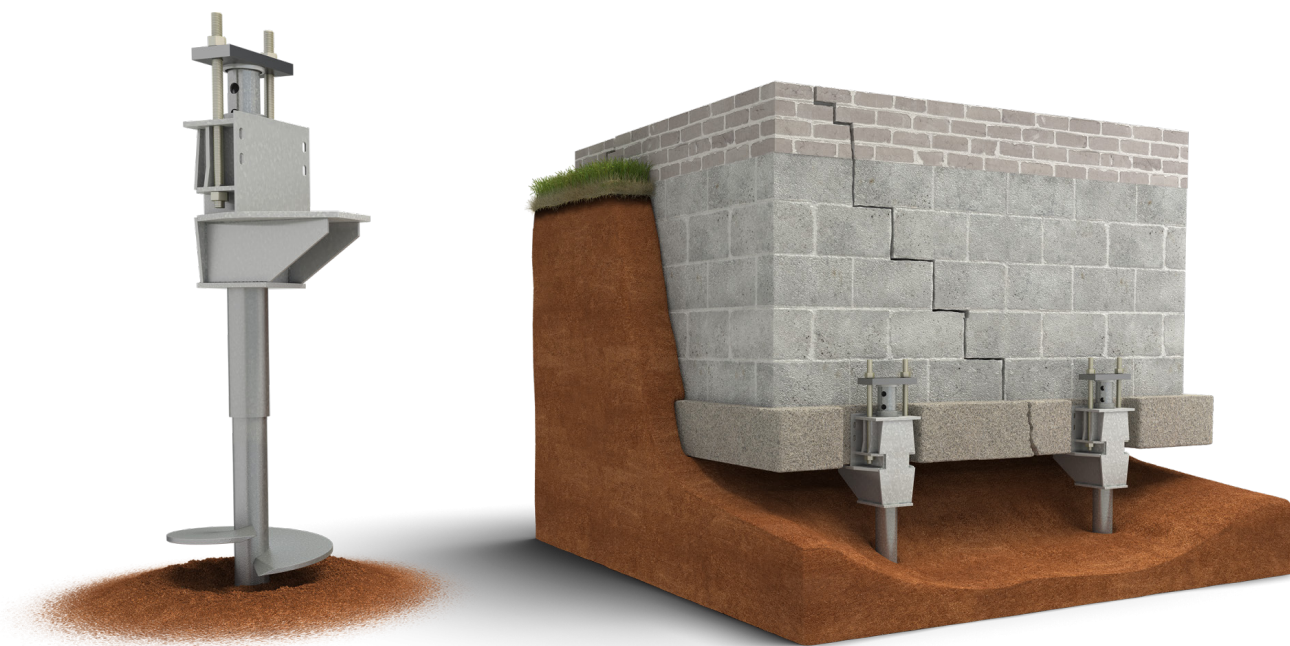
Law Improvements

Technical Features

Helical piers are suitable for light and heavy load. They can safely work through 50 ft. or more for required footings. They are helpful in wetlands where there might be many feet of loose organic material and soil to work through. The helical piers do not rely on the weight of the structure for depth and capacity like most other structures do. They have a round shaft that has a high resistance to bending for maximum weight distribution. They also provide an opportunity to attempt to lift any foundation that needs fixing.



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Helical Piers

How They Work

Helical piers work by the use of a machine that screws or threads the piers into the soil. Piers can be screwed in by a special attachment that is made for many skid-steer loaders or an excavator. The piers are environmentally friendly and vibration free which causes minimal disturbance to the surrounding environment. These piers will be screwed in level, or at a slant to the structure with a foundation bracket that is positioned on top. These piers can even be screwed into the ground when it is frozen during the winter months, giving the installers a year round schedule.

When To Use

The use of helical piers are used when a home needs to be lifted from its previous foundation that may be sunken. They can be used on lighter structures as well such as decks, sheds, and boat houses. They are also used when a normal foundation is too much for the soil conditions so the use of helical piers is used for minimal disturbance. The piers may also be used for board walks, near a lake or river.



Site Inventory

1) Area - 70 acres

- i) Developed Land - 25 acres
 - a) Residential - 18 acres
 - b) Commercial - 7 acres
- ii) Woodland - 35 acres
- iii) Wetland - 35 % of Total Site
- iv) Water - 10 acres (100' off shore)

2) Water Bodies

- i) North Long Lake
 - a) Merrifield Bay
 - b) 3380' of Shoreline
- ii) Sugar Bush Creek
 - a) 1500' long

3) Water Quality

- i) Phosphorus 14 (ug/L)
- ii) Chlorophyll 5 (ug/L)2
- iii) Kieldahl Nitrogen .5 (mg/L)
- iv) pH 8.2
- v) Suspended Solids 1.5 (mg/L)
- vi) Total Nitrogen to Phosphorus 35:1

4) Soils

- i) D49D & D53B
 - a) Fine-medium sand or loamy sand over very fine sand and silt
 - b) Fine texture material, holds water
 - c) Moderately well drained
 - d) Slow surface runoff
 - e) Undisturbed: 2-3" deciduous forest litter. 4-8" loose loamy sand. 5-8" loose sand to highly mottled sandy loam/ acidic to 30-40"

5) Public Amenities

- i) North Long Lake Public Access
 - a) Boat Ramp
 - b) Truck & Trailer Parking
- ii) Train Bell Resort
 - a) Recreational Water & Land Activities
 - b) Lodging
 - c) Cabins

Site Inventory

- d) Villas
- e) Boat Rental
- iii) Paul Bunyan Trail
 - a) Multi-use Recreational
 - b) 112 Miles
 - c) Asphalt Surface

6) Wildlife

- i) Reptiles
 - a) Turtles
 - b) Snakes
 - c) Others
- ii) Amphibians
 - a) Frogs
 - b) Toads
 - c) Salamanders
 - d) Others
- iii) Mammals
 - a) Squirrels
 - b) Deer
 - c) Chipmunks
 - d) Rabbits
 - e) Raccoons
 - f) Foxes
 - g) Beavers
 - h) Otters
 - i) Skunks
 - j) Bats
 - k) Coyote
 - l) Others
- iv) Birds
 - a) Eagles
 - b) Ducks
 - c) Blue Heron
 - d) Geese
 - e) Hawks
 - f) Grouse
 - g) Owls
 - h) Songbirds
 - i) Shorebirds
 - j) Others

Site Inventory

v) Fish

- a) Largemouth Bass
- b) Small-mouth Bass
- c) Walleye
- d) Northern Pike
- e) Dog Fish
- f) Crappie
- g) Perch
- h) Sunfish
- i) Bluegill
- j) Others

vi) Insects

- a) Pollinators
- b) Arachnids
- c) Ants
- d) Decomposers
- e) Others

7) Plants

i) Trees

- a) Red Pine
- b) White Pine
- c) Yellow Pine
- d) Aspen
- e) Paper Birch
- f) Common Sugar Maple
- g) White Oak
- h) Red Oak
- i) Beech
- j) Black Ask
- k) Others

ii) Shrubs

- a) Sumac
- b) Vibernum
- c) Dogwood
- d) Winterberry
- d) Others

iii) Turf Grass

iv) Grasses

- a) Native & Exotic Mix

v) Aquatic

- a) Emergent & Submergent Mix

vi) Moss/Lichen/Fungi



Site Inventory

8) Climate

- i) Macro
 - a) Humid Continental
- ii) Micro
 - a) Protected
- iii) Prevailing Winds
 - a) Winter - NW
 - b) Summer - SW
- iv) Annual Precipitation
 - a) Rainfall - 27"
 - b) Snowfall - 43"
- v) Temperatures
 - a) Average High (July) is 80°F
 - b) Average Low (January) is -1°F

Performance Criteria

Executive Summary

This thesis project requires performance criteria that will measure the effectiveness of this project's landscape solutions to fulfill their intended purpose to contribute to sustainability. It will involve the categories of Space Allocation, Environmental Impact, Social Impact, Economic Impact, and Code Compliance to specify the performance criteria with relevance to the site's design.

Space Allocation criteria will guide the site's design to ensure that all the site's criteria are fulfilled. This will be included for both residential and commercial job sites that are included in my site. The performance will be measured for residential property by the utility requirements, recreational requirements, hardscape to softscape ratio, and habitat. The performance criteria for commercial will be measured with the same requirements, but with the added structures, event spaces, parking, and water access.

Environmental Impact criteria will guide the design to limit the site disturbance and making use of existing infrastructure. The design will also have an efficient stormwater management plan that will include retaining, detaining, and treating runoff on-site that will simultaneously help improve the site's water quality. The design will protect and restore functional ecosystems to help improve the ecological integrity of the existing habitats. This will lead to the overall populations and species biodiversity.

Social Impact criteria will ensure that the design will efficiently increase the overall social value of the area. This will lead to the promotion of recreational and social value, and the health and quality of life. The design criteria will improve safety and the perception of danger on the site. Noise mitigation will measure acoustic levels and reduce undesirable sounds. Improving the visual quality of the area and access to the design will be measured as well.

Economic Impact criteria guide the design to add to the value of the site and adjacent properties. Reducing ongoing costs of maintenance will be implemented as well. The installment of the site's design will also increase their own company's benefits as well from showcasing their site.

Code Compliance criteria will ensure that the project will follow the requirements determined by the state, county, and municipality laws. Due to the site's location of the shoreland district, there will be many laws and setbacks included in this project that will have to be perfectly followed

Space Allocation

1) Performance Measure (Residential)

a) Utility:

- i) Septic System
- ii) High Voltage
- iii) Low Voltage
- iv) Irrigation

b) Recreation:

- i) Yard
- ii) Fireplace
- iii) Patio
- iv) Outdoor Living
- v) Beach
- vi) Trails

c) Hardscape to Softscape Ratio:

- i) 1:6

d) Habitat:

- i) Native Plants
- ii) Habitat Preservation
- iii) Runoff Control

2) Performance Measure (Commercial)

a) Utility:

- i) Septic System
- ii) Low Voltage
- iii) Irrigation

b) Recreation:

- i) Green Space
- ii) Amphitheater
- iii) Sports Area

c) Hardscape to Softscape Ratio:

- i) 2:6

d) Habitat:

- i) Native Plants
- ii) Habitat Preservation
- iii) Runoff Control

Performance Criteria

Environmental Impact

1) Performance Measure (Residential)

- a) **Land Efficiency & Preservation:**
 - i) 75% Undisturbed
- b) **Stormwater Management:**
 - ii) 90% Retained Runoff
- c) **Water Quality:**
 - i) 100% Increase
- d) **Light Quality:**
 - i) 100-200 Lumens
- e) **Habitat Preservation:**
 - i) 75% of Total Area
- f) **Population & Species Richness:**
 - i) 150% Increase

2) Performance Measure (Commercial)

- a) **Land Efficiency & Preservation:**
 - i) 50% Undisturbed
- b) **Stormwater Management:**
 - i) 75% Retained Runoff
- c) **Water Quality:**
 - i) 75% Increase
- d) **Habitat Preservation, Restoration, & Quality:**
 - i) 50% of Total Area
- e) **Population & Species Richness:**
 - i) 150% Increase

3) Performance Analysis Tools

- a) TR-55, Google Earth Pro, AutoCad, GIS

4) Performance Judgment

- a) **Criteria will be met and demonstrated through plan view documents to give an estimate of the how the criteria will be shown. Further detail will be shown through the design documentation. Each property size will vary with percentages determined by site, habitat, and slope**

e) Structure:

- i) Restaurant
- ii) Bar
- iii) Seating
- iv) Light Poles
- v) Piers
- vi) Trails

f) Event Space:

- i) 30% of Total Area

g) Parking:

- i) 75-150 Car Spaces
- ii) 25-50 Truck & Trailer

h) Water Access:

- i) Boat Launch

3) Performance Analysis Tools

- a) Google Earth Pro, AutoCad, GIS

4) Performance Judgment

- a) **The Space Allocations will be met by the design documents that will list exact measurements and usage regarding the performance criteria listed**

Economic Impact

1) Performance Measure (Residential)

- a) **Property Value:**
 - i) \$85,000 Increase
- b) **Maintenance Savings:**
 - i) 15% Increase

1) Performance Measure (Commercial)

- a) **Property Value:**
 - i) 10% Total Lake
- b) **Economic Development:**
 - i) 150% Increase

2) Performance Analysis Tools

- a) GIS, Professional Interviews

3) Performance Judgment

- a) **This criteria will be met by following the standards and other performance criteria's correctly. These are estimated values, although they hold true to the relevant job sites being designed**

Performance Criteria

Social Impact

- 1) Performance Measure (Residential)
 - a) Recreational & Social Value:
 - i) 95% Engagement
 - b) Health & Well Being:
 - i) 90% Promotion
 - c) Safety:
 - i) 100% of Total Site
 - d) Acoustic levels:
 - i) 80% Positive
 - e) Scenic qualities & Views:
 - i) 50% Increased Views
 - f) Access & Equity:
 - 1) 75% of Total Users
- 2) Performance Measure (Commercial)
 - a) Recreational & Social Value:
 - i) 50,000 Yearly Customers
 - ii) 95% Engagement
 - b) Health & Well Being:
 - i) 90% Promotion
 - c) Safety:
 - i) 100% of Total Site
 - d) Acoustic levels:
 - i) 70% Positive
 - e) Scenic qualities & Views:
 - i) 20% Increased Views
 - f) Access & Equity:
 - i) 95% of total Users
- 3) Performance Analysis Tools
 - a) SOPARC, Google Earth Pro, AutoCad, GIS, SketchUp
- 4) Performance Judgment
 - a) Criteria will be met through analysis and surveys of people who use the site and will be given an example of the ambient noise levels. These sites will use this criteria to increase all of the different measurements



Performance Criteria

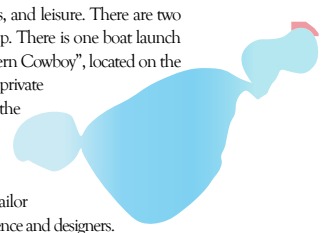
Code Compliance

- 1) Performance Measure (Relevant)
 - a) State Law Agencies:
 - i) Minnesota Department of Natural Resources (MnDNR)
 - ii) The U.S. Army Corps of Engineers (Corps)
 - b) County Law Agencies:
 - i) Local Government Unit (LGU)
 - ii) Department of Land Development (DLD)
 - iii) Crow Wing County Land Services
 - c) Municipality Law Agencies:
 - i) Building Department
- 2) Performance Judgment
 - a) Criteria will be met by the site design following the laws and guidelines of the Agencies that relate to shoreland development

The Shoreland District



North Long Lake is located North of Brainerd, but is still considered to be located in the "Brainerd Lakes area". This lake is full of residents who fish for walleye and bass, water sports, and leisure. There are two sand bars, one on the North and South channel, typically about 1' to 5' deep. There is one boat launch located on the North "Merrifield Bay" and one restaurant called "The Northern Cowboy", located on the South "371 Bay". My site location is on Merrifield Bay, which includes much private residential housing, the boat launch, and a resort on the far end located near the boat launch. This lake is more relaxed than some other popular lakes in the area such as "Gull Lake". This is great for the residence on the lake, so they can appreciate their time here with very little boat traffic. Although, there is the occasional party for events being the 4th of July, with an occasion parasailor skipping across the water. North Long Lake's opportunities are endless for residence and designers.

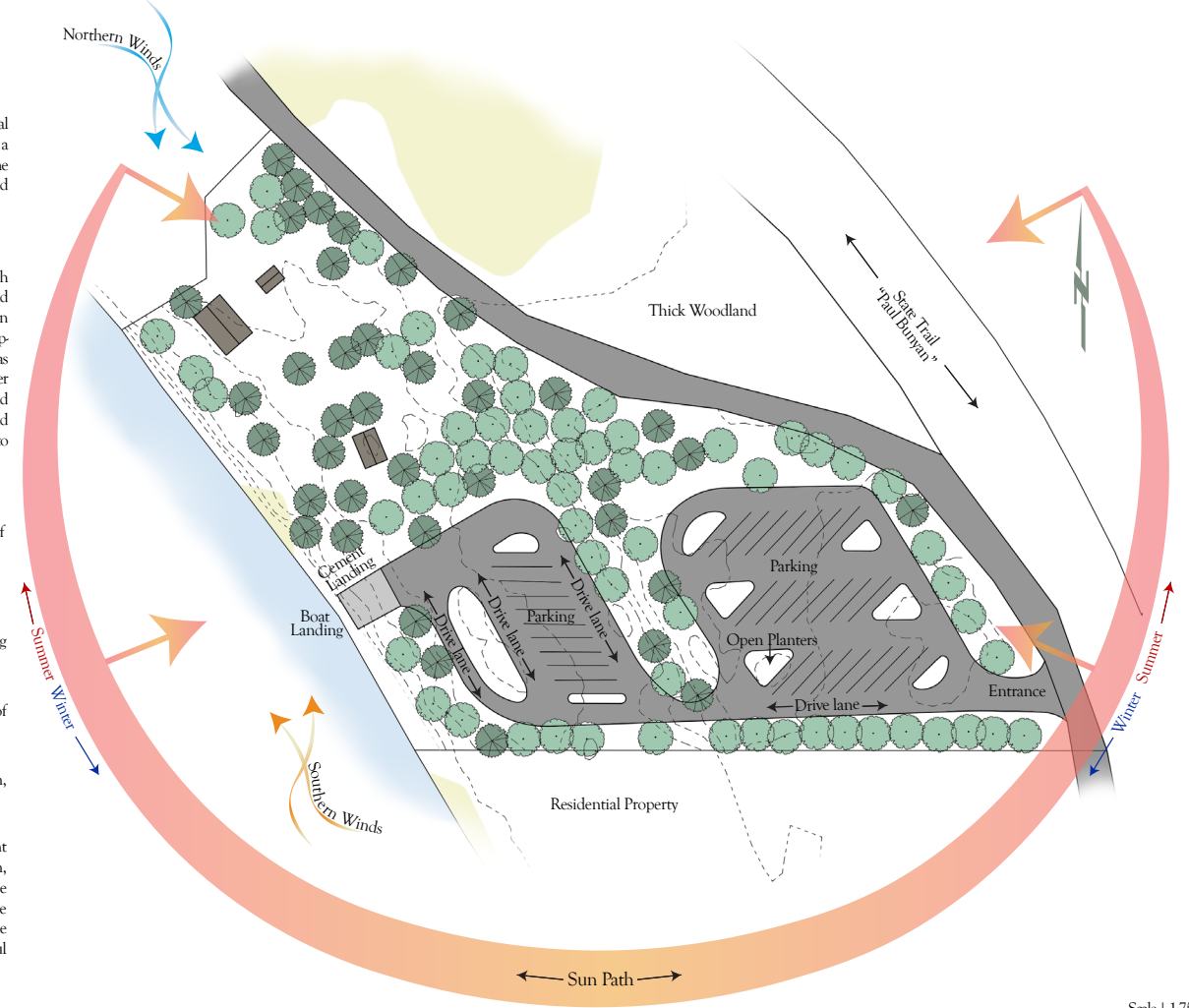


Waterfront Commercial District

The purpose of this district is to accommodate commercial uses in the shoreland district where access to and use of a surface water feature is an integral part of the business. The primary uses in this district are marinas, resorts, and restaurants with transient docking facilities.

Site Characteristics:
This parcel of land consists of a lightly woodland area, with limited development. The state owns only the parcel of land that consists of the boat launch and parking, but the Northern neighboring land can be transitioned into a commercial property if need be by buying off segments of the land. This site has generic parking lots that are equipped for truck and trailer parking and movement. The site lacks land and landscaping, and all the planters are overgrown with weeds and prairie grass. There are very few wetlands to incorporate into designs, which will give an opportunity for more futures.

- Site Promotions:**
- Promote business property by enhancing the attraction of the commercial district to residents, visitors and tourists with uniform lot width and area, and setbacks from the lake.
 - Improvement of appearance through good landscaping and natural trees for screening.
 - Manage storm water runoff to provide for the protection of natural and artificial retention areas, and public waters.
 - Establish a reasonable design, construction, installation, and maintenance of the site.
 - To alleviate potential traffic on local streets and adjacent highways to provide adequate parking, traffic circulation, and safety. The adjacent road consists of a multi-use vehicular and pedestrian traffic that is shared along the road. A potential redesign may be suitable to enhance pedestrian safety along the road and coming from the Paul Buryan Trail.



Scale | 1:75

Residential Shoreland District

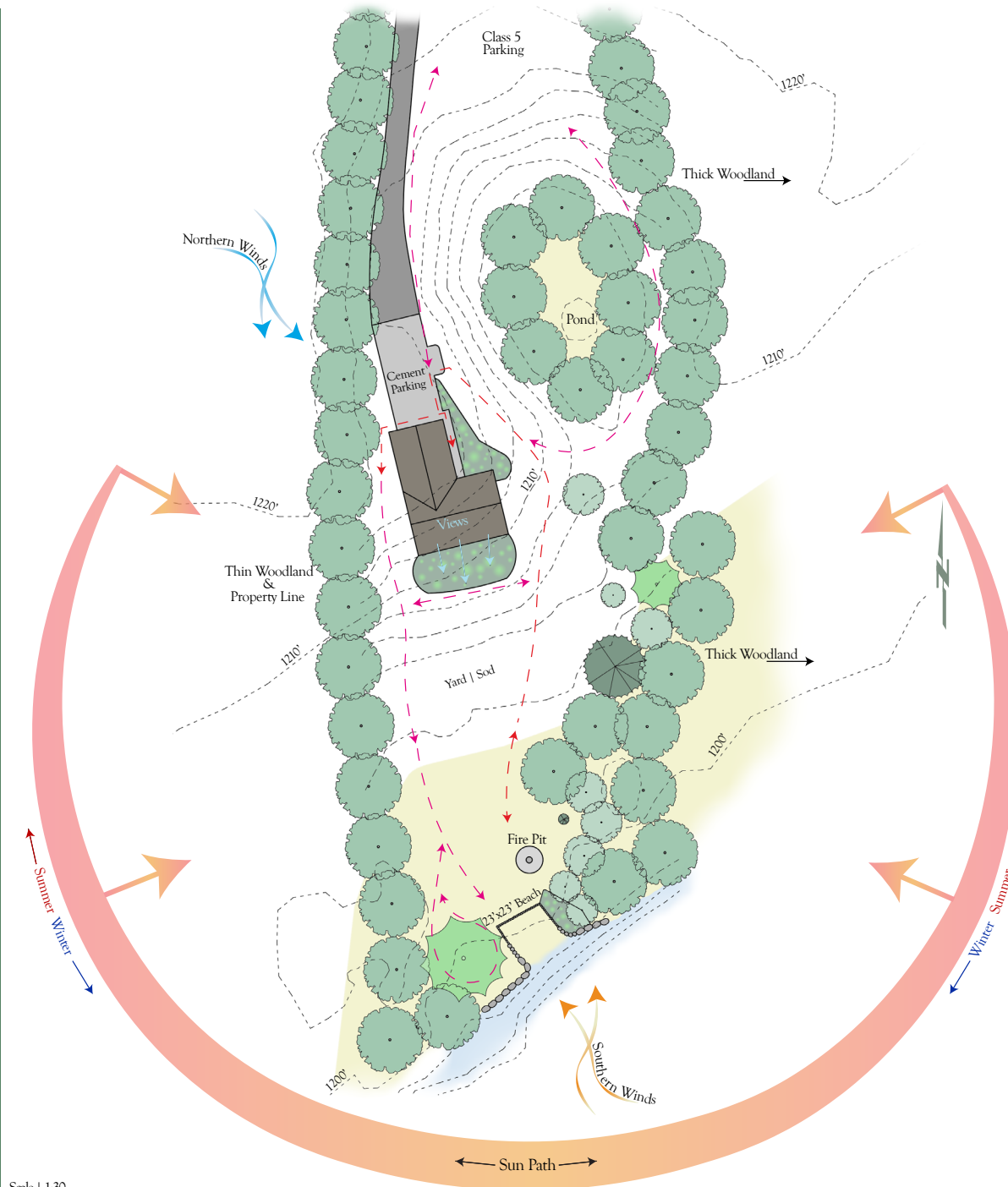
The purpose of this district is to preserve and enhance the quality of surface waters, conserve the economic and natural environmental values of shorelands, protect drinking water sources, and provide for the wise use of water and related land resources. The primary use within this district is seasonal and year-round single-family residential.

Site Characteristics:
This parcel of land consists of heavy woodland surroundings with above-average slopes. Most of this area's yard is not far from the Ordinary High Water Line (OHWL) and is located in the wetland, meaning the majority of the lower areas of this property will be moist and may consist of moss, rather than grass. This property has previously removed the natural wetland has tried to replace it with sod. This will result in high water runoff into the lake, harming the water's ecosystem. In order to solve this, there will have to be an improved buffer zone. The views of this property are in well, therefore there will need to be no site clearing, only to reduce the size of the yard, and restore the wetland.

Site Tree Species:
Oak | Ash | Maple | Beech | Birch | Aspen | Spruce
White & Red Pine

- Existing Planting Bed**
Many plants are invasive and do not serve the ecosystem. Planting bed will be removed or improved in the design stage.
- Wetland**
This area's design will be of the most importance, due to its involving characteristics on the environment.
- Main Circulation**
Primary foot paths, most likely will utilize throughout design.
- Secondary Circulation**
Foot paths are only used when needed, not as important to include these into the overall design.

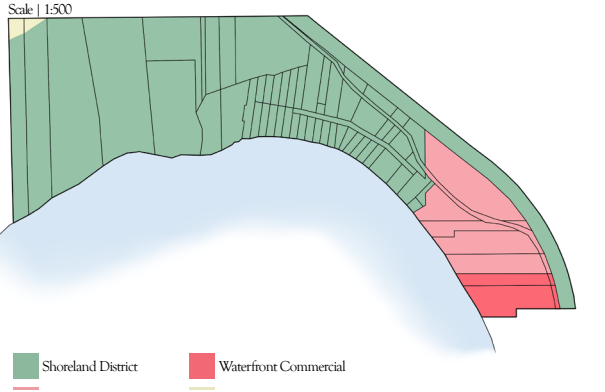
Prevailing Winds
The Southern wind will bring warm air from the South. These winds will primarily be coming from the lakefront, which in some cases, the lake water will cool the air. The Northern winds will bring cooler air from the North. These winds are extremely reduced because of the thick woodland that surrounds the site. Although, some of these Northern winds may wrap around the lake, and blow through the lakefront from across the lake.



Scale | 1:30

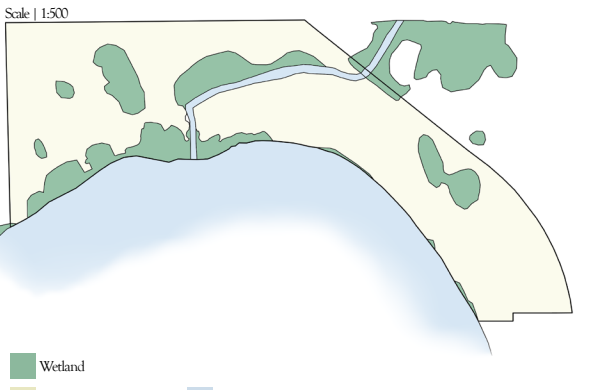
Parcels & Land Use:

The area of this land is approximately 70 acres. The majority of the site is made up of the Shoreland District, which will primarily be residents who live there lakeside. The next largest area is Commercial District 2, which are located along federal, state, county, or township roads. The next area is called the Waterfront Commercial District, which are used for marinas, resorts, and restaurants. The smallest area of the site is the Rural Resident District.



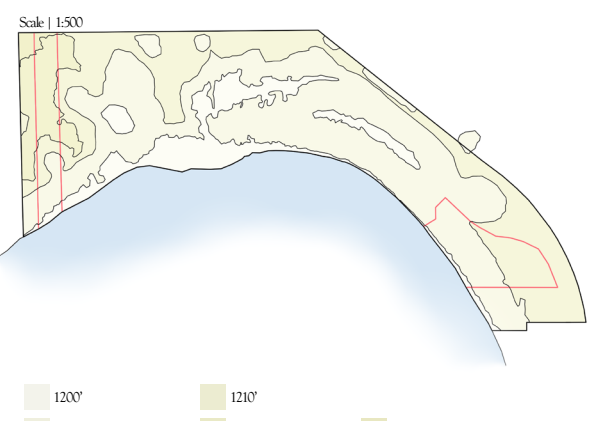
Wetlands:

Of the approximate 70-acre site location, about 35% of it consists of wetlands or streams. Wetlands are classified as lands consisting of marshes, swamps, and saturated land. In these areas, the site should focus on preserving and restoring the natural habitat. Residents who have a wetland in their property should focus on a proper buffer zone. This would be the area maintained around the shoreline or edge of a stream or wetland.



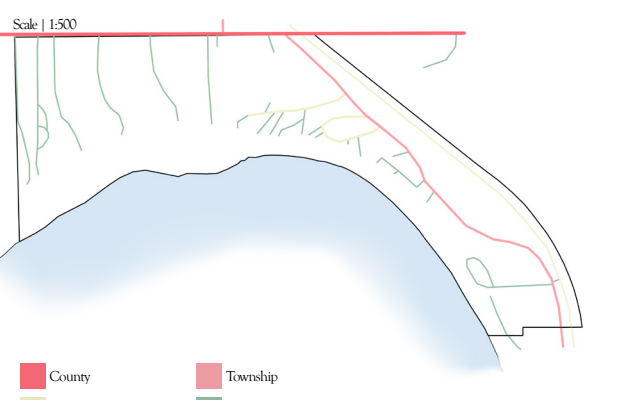
Topography & Site Locations:

Throughout this site topography changes at most 24' in elevation from the road, and trail to the water's edge. The site creates four areas that makeup ponds, swamps, and marshes. Highlighting in red are the two site locations. The Residential District on the left is about 5 acres. The Commercial District on the right is about 4 acres.



Roads & Trails:

The site has few roads, but many driveways, and trails. The county only has one road that runs across the North of the site called County Road 127. The township has one road that enters the site that belongs to the township named Train Bell Rd. There are a few private roads as well, the northernmost are named Fern Leaf Ln., then below it is named Cottage Ln.



Site Setbacks & Buffer Zones

Setbacks

State Shoreland rules establish minimum setbacks from the Ordinary High-Water Table (OHWT) of lakes and rivers, and from the top of bluffs.

Non-Wetland

1. Shed or structure is at least 20' from the OHWT (with permit)
2. Shed or structure can be 120 sq. ft. but the front must be behind the setback
3. No building restrictions after 75' from the OHWT
4. A 4' wide walkway or stairway within the lake setback is allowed with a permit

Wetland

1. For structures and hardscapes, 20 sq. ft. is allowed within 20' of the OHWT (with permit)
2. For structures and hardscapes, 400 sq. ft. allowed after 75' from OHWT (with permit)
3. An 8' wide elevated boardwalk for the lake access over wetlands is allowed (with permit)

Note: The development of these will be considered as fill or an impervious service

Lake Beach Frontage

1. Length is limited to 30% of shoreline or 200' max
2. Permit required for <10% slope
3. Can add up to 10 yds of sand each year

Patios

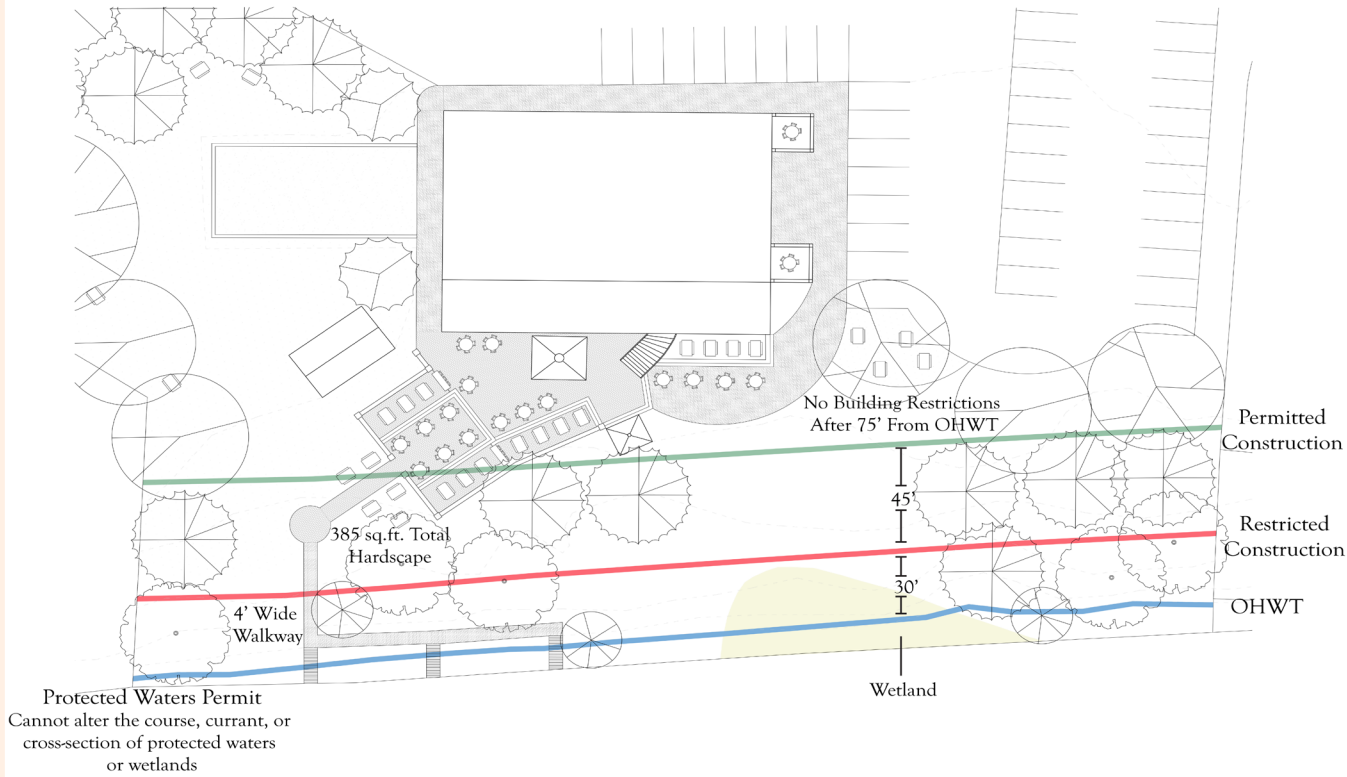
1. Permitted 250 sq. ft. but can be up to 400 sq. ft. with implemented SW management plan (Article 41)
2. Cannot be 1' below or above the natural ground level

Note: Patios are allowed behind the structure setback without a permit

Residential



Commercial



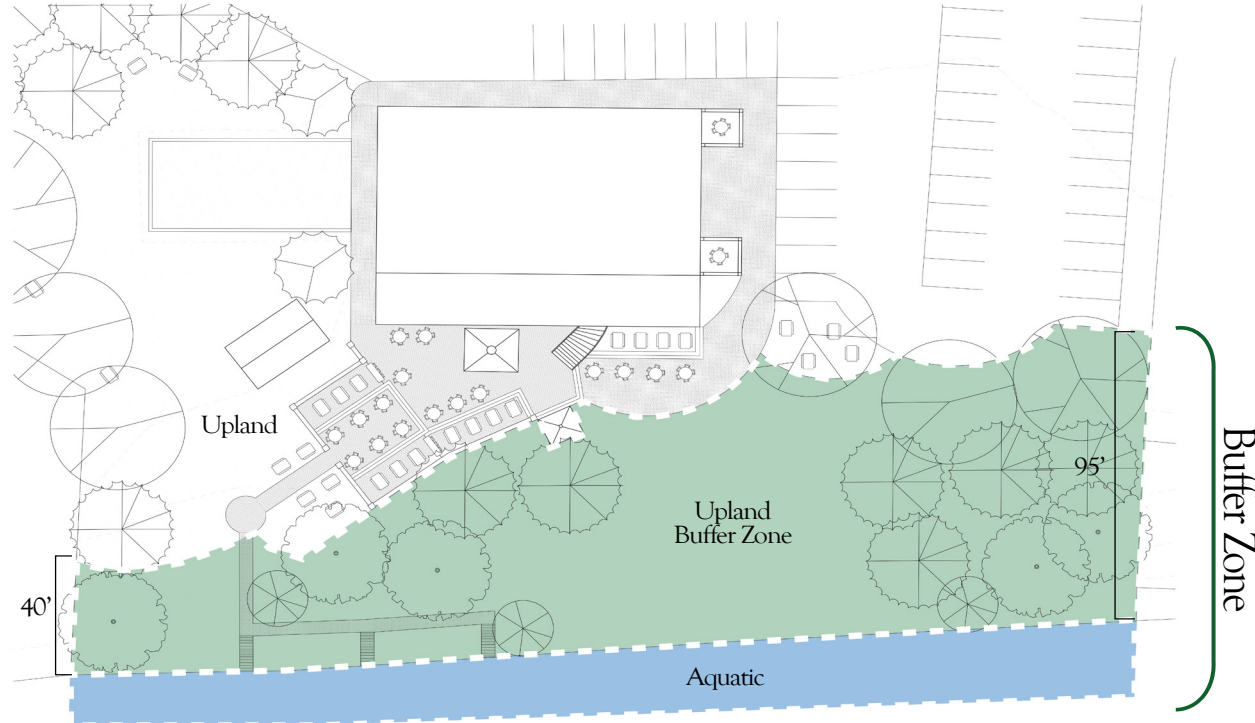
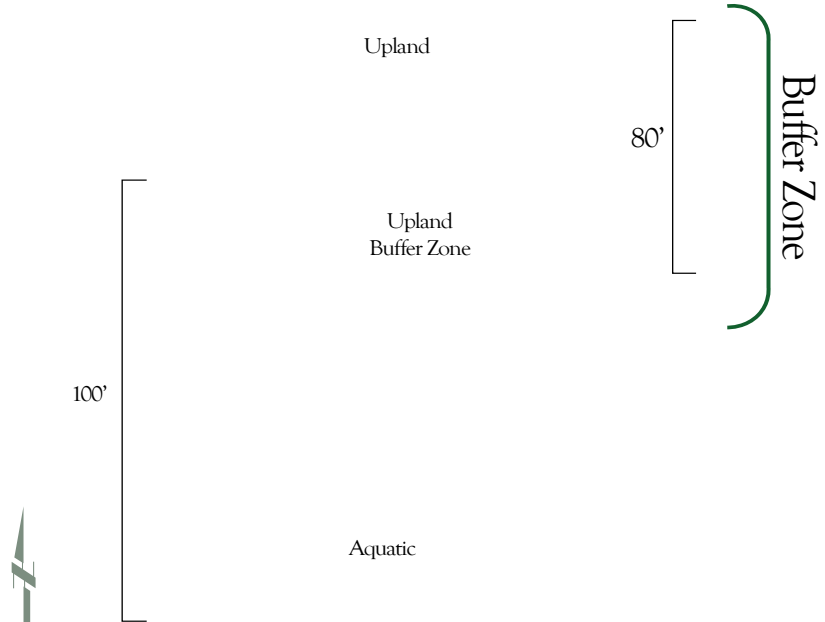
Buffer Zone

This zone is the main component of landscaping for wildlife and water quality. It restores ecological functions and have other structural benefits such as erosion control, pollution control, and stabilization. There is a three-step process to construct this:

1. Identify the improvements
2. Design a natural buffer zone at least 3/4 of the lake frontage
3. Restore native plants in the area

Dimensions

1. 25' to 100' from the water's edge
2. Mn setbacks require at least 25' (county dependent) called the "shore impact zone"
3. 50% to 75% of shoreland frontage
4. Native plantings



Design Concept | Commercial

This concept consists of upgrading the boat launch landing with better grades, and planting beds with a new surface layer. The other section is a proposed Zorbaz restaurant location. The restaurant location is more important to have an enhanced buffer zone due to the larger yard spaces and patios that will have more surface runoff. Each area is placed to help circulation, frame the views from the dining and gathering areas, and will enhance the overall economic, social, and environmental impact to North Long lake.

- 1. Boat launch landing entrance
- 2. Truck & trailer parking
- 3. Updated planting beds
- 4. Boat launch
- 5. Boat launch & restaurant plant divider
- 6. Restaurant entrance
- 7. Drop off zone
- 8. Zorbaz restaurant
- 9. Private dining
- 10. Amphitheater
- 11. Gazebo
- 12. Runner's shack
- 13. Sand volleyball
- 14. Open yard space with area seating
- 15. Dining & entertainment plaza
- 16. Dining & entertainment plaza
- 17. Green picnic seating space
- 18. Formal Landscape
- 19. Zorbaz photography patio
- 20. Natural pathway
- 21. Natural plantings (waters edge to upland dry)
- 22. Natural landscape
- 23. Wetland herbaceous landscape
- 24. Natural woodland

Note- The planting scheme of the site transitions from each buffer zone with natural plants. This large planting scheme will enhance the surrounding habitat while also absorbing harmful chemical and stormwater runoff. Without this, it would allow sediments to runoff into the lake and cause unwanted algae blooms which can be harmful the lake ecosystem.



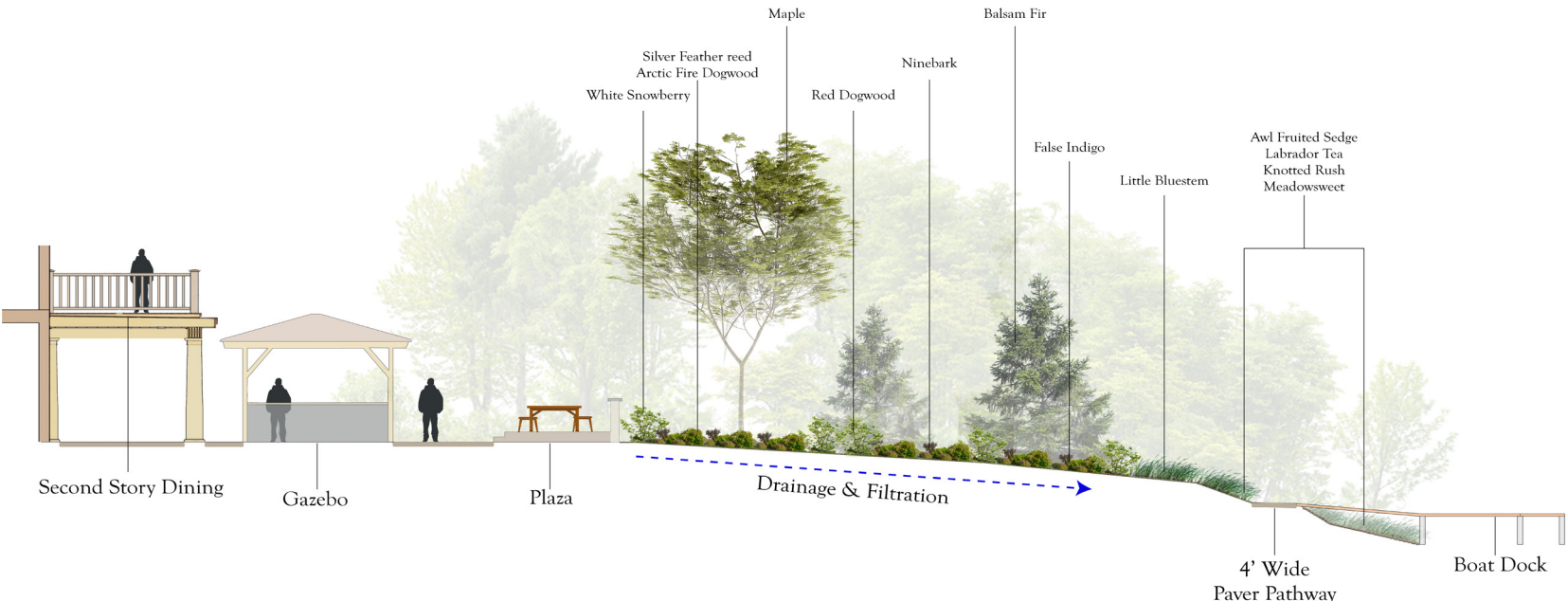
Site Design | Commercial

This detailed site plan is an accurate representation of the plantings and materials used in the site. The site is ADA accessible with alternative routes and at most 3% slopes on the hardscaped paths. All plants are chosen for their hardiness zone, stabilization, native selection, and landscape value. The follow are more in-depth site characteristics:

- 1. Zorbaz restaurant with optional indoor and sheltered outdoor seating
- 2. Private seating which is elevated to the second story with overhead string lights and optional acoustics
- 3. Staircase from the second story to the main outdoor plaza
- 4. Gazebo which will serve as an outdoor bar for the plaza
- 5. Runner's shack for the people serving food
- 6. Amphitheater for live bands and entertainment for the outdoor plaza, yard, and sand volleyball. The acoustics form this are also intended to reach the lake for nearby boats
- 7. Yard space for sports and lounging. This area will have selected picnic style seating in shaded areas
- 8. Zorbaz photography plaza used as most Zorbaz restaurants for their advertising
- 9. Green seating for a change of atmosphere
- 10. Dining and entertainment plaza. This area will have different levels and types of seating
- 11. Dining area for customers who want a direct view of the lake
- 12. Green seating for a private atmosphere
- 13. Zorbaz parking and circulation
- 14. Formal planting beds near high traffic areas
- 15. Natural pathways through the landscape to help with circulation to boat dock and desired entry
- 16. Natural landscape with selected planting for landscape value
- 17. Natural planted landscape used for filtration of yard pollutant runoff
- 18. Wetland herbaceous planting for soil stabilization
- 19. Boat dock access



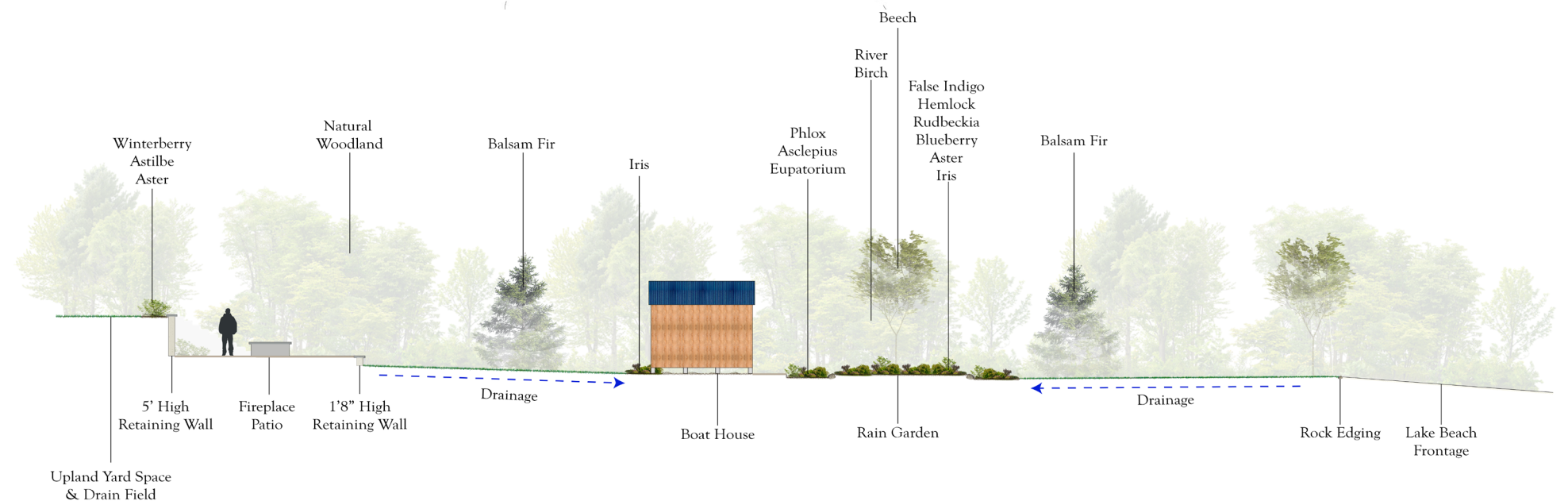
Note- Materials chosen for this site are selected by the common materials used at Zorbaz restaurants



Design Concept | Residential

This concept consists of designing the yard to benefit the environment by following the buffer zone rules while also giving the property owner the most potential for their yard. Each area is carefully placed to help circulation, frame the views from the house to the lake, and enhance the overall economic, social, and environmental impact.

1. Wetland/pond with bolder retaining wall
2. Concrete Parking Platform
3. Neighboring pathway
4. Entryway/greeting area
5. Entertainment bar, seating, & gas fireplace under the finished deck with 4 season porch
6. Septic tanks
7. Drain field/yard space
8. Landscaped retaining wall with dual floating stairs directed towards the fireplace patio and the lake entry. 9. Will contrail a lighted waterfall in the center for lakeside attraction
10. Fireplace patio
11. Transitional yard space draining towards the raingarden
12. Landscaped yard boarder for visual appeal, fading into the natural landscape
13. Green bridge with drainage pipes underneath for water flow
14. Raingarden
15. Boathouse, electrical, & irrigation controls
16. Paver pathway for boathouse entrance and lake access
17. Transitional yard space draining back towards the raingarden
18. Open space for irrigation pump
19. Lakeside landscape for visual appeal
20. Lakeside landscape for visual appeal
21. Lake beach frontage
22. Natural landscape



Site Design | Residential

This detailed site plan is an accurate representation of the plantings and materials used in the site. All plants are chosen for their hardiness zone, stabilization, native selection, and landscape value. The follow are more in-depth site characteristics:

1. Entertainment bar, seating & gas fireplace. This will be underneath a finished deck that will have under story lights and air circulation. The plant selection of hasta's are chosen for their shade resistance and color interests. This are will have a direct view over the diverted stairs for an excellent lake view
2. Second story deck entrance that will also have dining and elevated views towards the lake entrance.
3. Open yard space over the drain field that will be used for entertainment and other activates
4. Landscapes retaining wall with dual floating stars directing circulation towards the fireplace patio or the lake entry. The placement of this retaining wall serves the purpose for holding in the drain field and septic system. Diverting the staircase contains a lighted waterfall for acoustics and boat traffic attraction
5. Fireplace patio for entertainment and more lakeside views. This are will also have wood storage and hidden electrical outlets from the retaining wall
6. Transitional yard space for activities and space between the different site elements to reduce congestion
7. Paver pathway to direct traffic from the West side of the site and for boat house entrance. This pathway will also have drainage pipes for rainwater flow
8. Boat house which will contain electrical components, lake activity storage, and irrigation controls
9. Raingarden filled with a variety of natural plants and will also direct the water flow from East to West. This area will consume and filter the stormwater from the North and South sides of the site
10. Green bridge that will be used for main traffic to the lake and easy access for portable coolers and other items. It will also have drainage pipes underneath for water flow from East to West
11. Transitional yard space for activities closer to the lake. This space also drained back towards the raingarden, which is why this space is allowed. In most cases their won't be a green space this close to the lake because of harmful pollutant runoff
12. Landscaped yard boarder for visual appeal and a boarder transition from formal to natural landscape

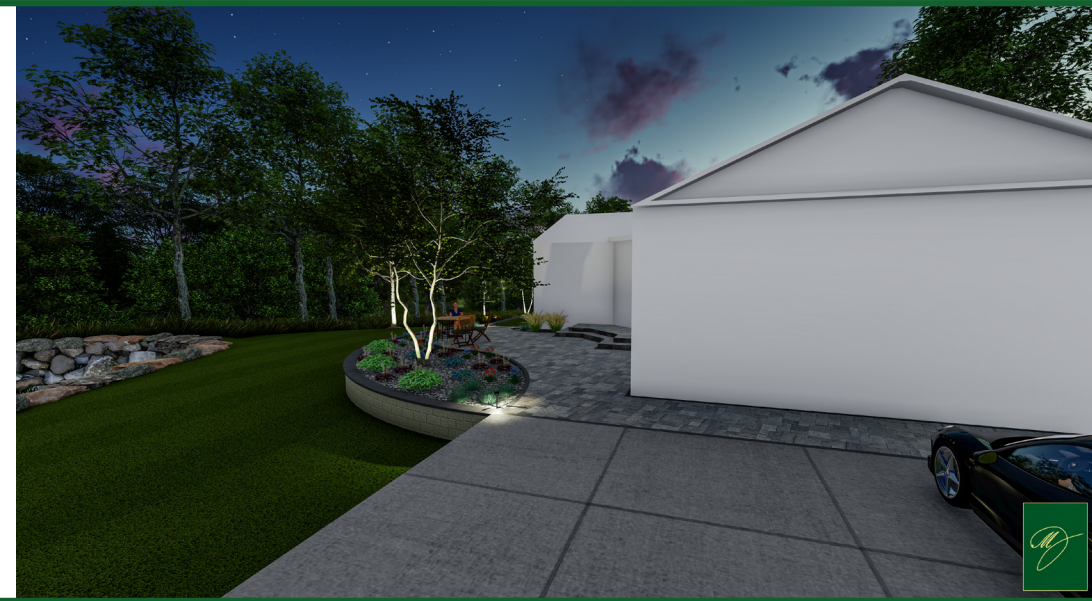
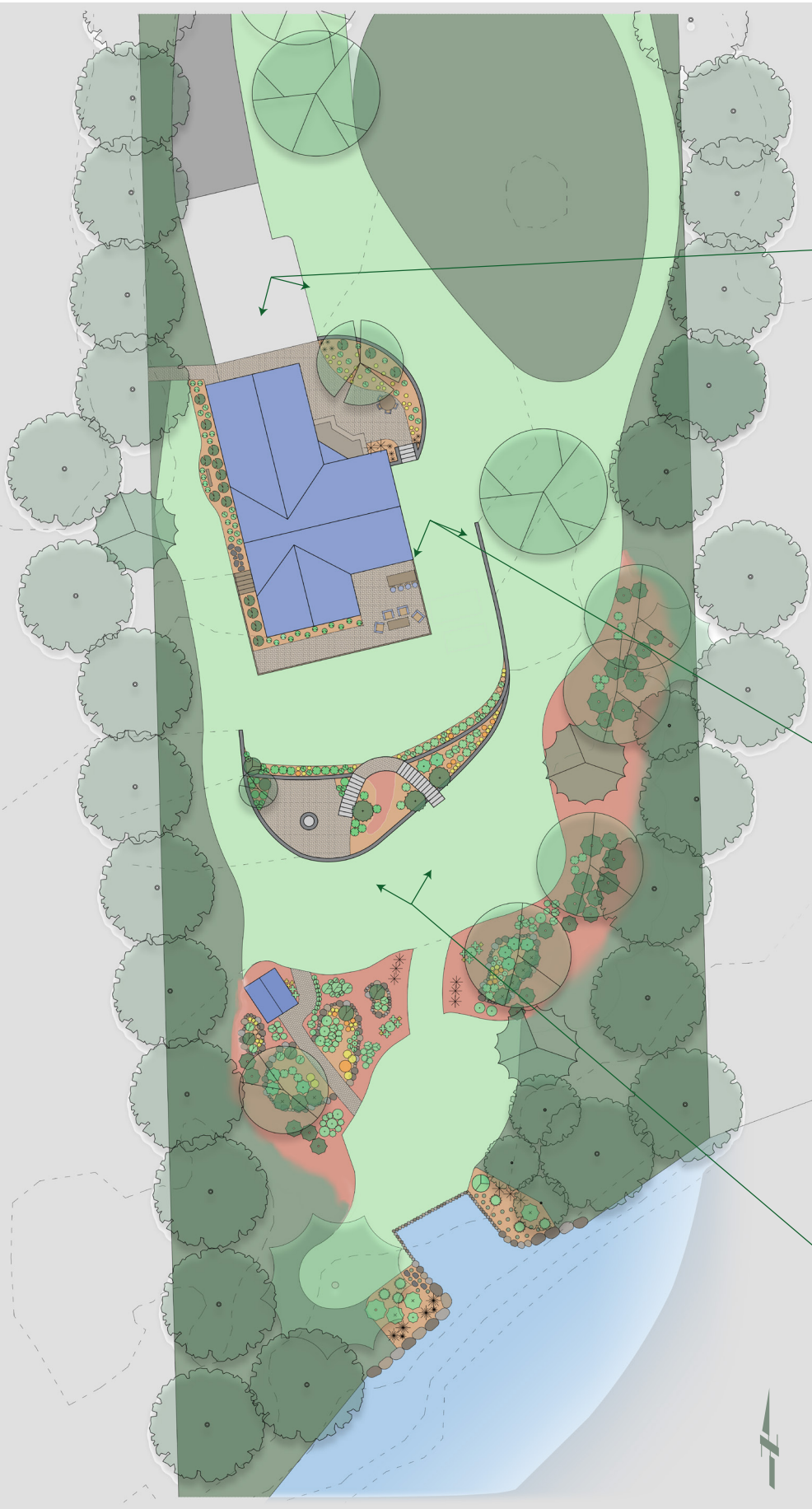
Note- The materials chosen for this site are:

- Black coping unit caps and versa-lock standard units colored bronze blend retaining wall blocks
- The patio block is willow creek slate stone colors shore blend with a willow creek black brick stone accent row.
- The stair treads are versa-lock standard color

Note- The site consists of a light plan which will be used to guide circulation and safety, and enhance the visual qualities of the plant selection



Residential Site Day & Night Perspectives



Residential Site Day & Night Perspectives

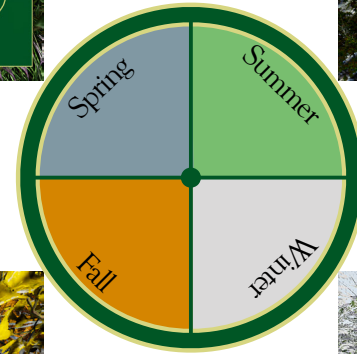
Day and night perspective of the rain garden and boat house. The paver pathway directs circulation from the boat house to the lake or vice versa, used for lake recreation storage and electrical controls. The green bridge is used for main circulation from the house to access the lake, which also has accent lights for user safety.



Day and night perspective of the boat views inward towards the clients landscape. This is an important view because boat traffic inspects other lake owners landscapes, in this case it will be great for advertising and showing off their landscape. It has a direct view towards the house, retaining wall, patio and waterfall. At night, boats will see the lighted waterfall and be drawn to its charisma.



Residential Site Seasons



Residential Field of Vision

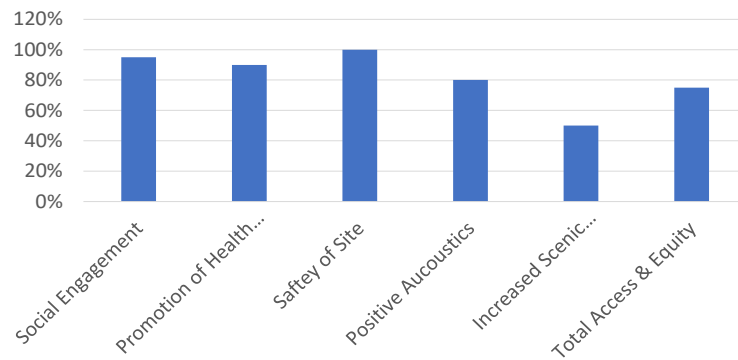


Summary Graphs | Conclusion

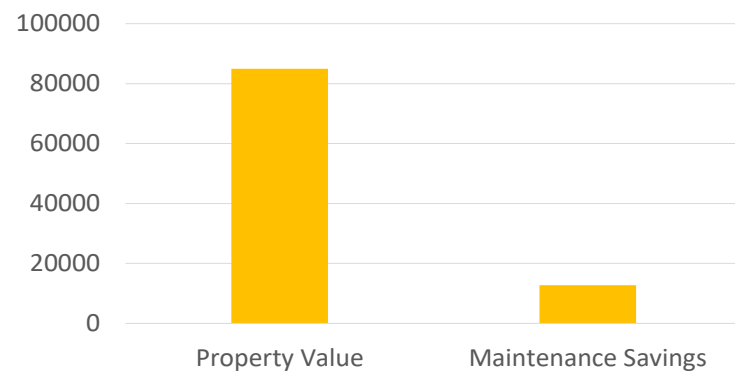
Residential

The graphs shown are the residential project's increased impacts for the site that will measure the effectiveness of this project's landscape solutions to fulfill their intended purpose to contribute to sustainability.

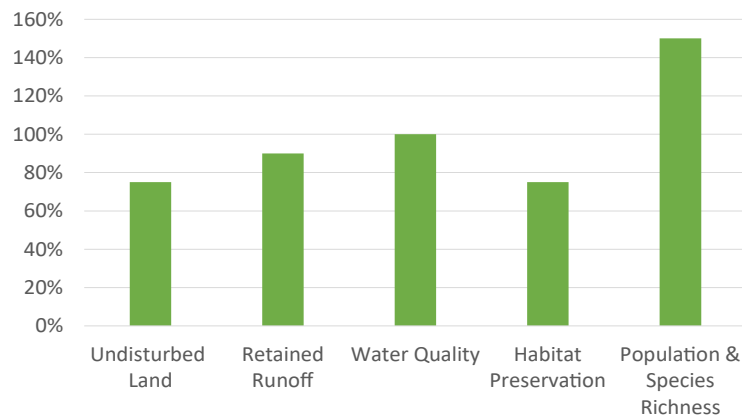
Social Impact



Economic Impact



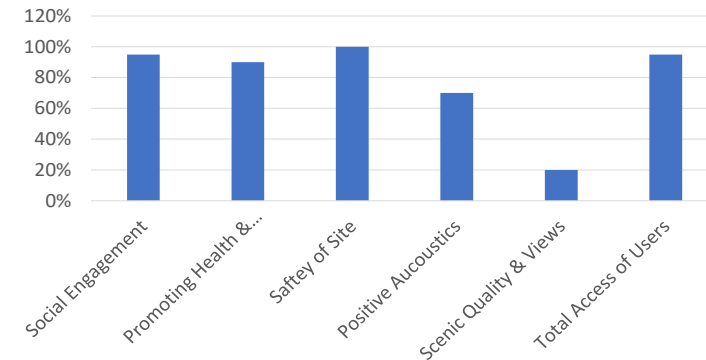
Environmental Impact



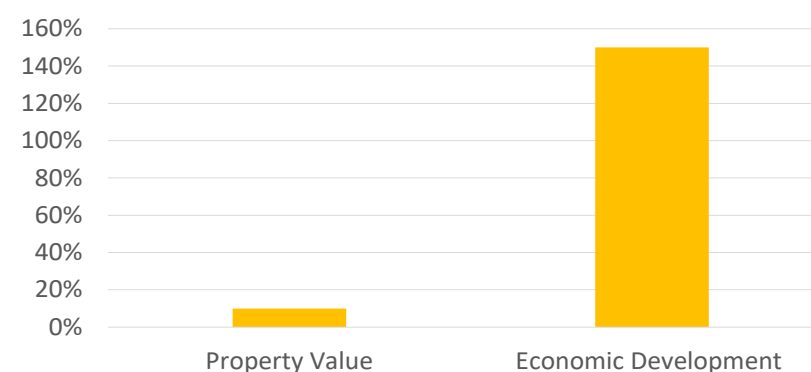
Commercial

The graphs shown are the commercial project's increased impacts for the site that will measure the effectiveness of this project's landscape solutions to fulfill their intended purpose to contribute to sustainability.

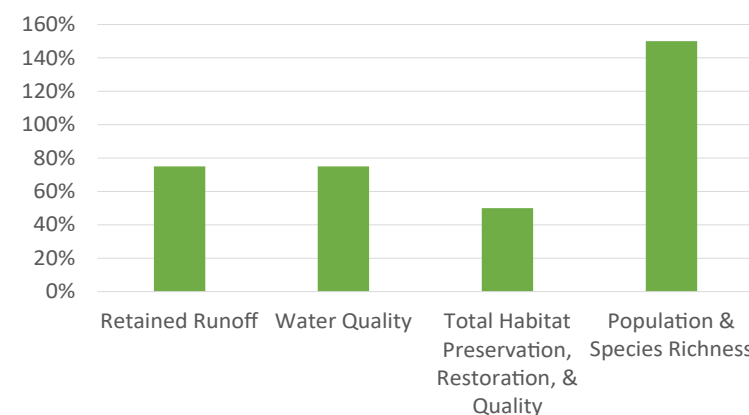
Social Impact



Economic Impact



Environmental Impact



This study concludes how important and correct techniques and examples on how to design for the Minnesotan Residential and Commercial shoreland district. It has provided how to improve lakeshore properties with the jurisdiction the government has over each property. This study will be used to show the public the possibilities they have when design their lakefront property and will hopefully put an end to illegal installations that negatively effect the habitat, ecosystem, and possibly their foundations. The major points I have made in this presentation are:

How to design with limited development because of laws and regulations (Law abiding installations)

Law Improvements

Educate the public on the importance of correct plantings and construction

Statistics of the increase in potentially harmful landscape installations, and how we can potentially solve this

Redefine designs for a better habitats, environments, and ecosystems



Appendix

References

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- State of Minnesota, Crow Wing County. "2014 CWC Water Protection Report". Retrieved from <https://crowwing.us/DocumentCenter/View/8775/2014-CWC-Water-Protection-Report>.
- Minnesota DNR Shoreline Alternations Fact Sheets: Natural Buffers, Lakescaping; Riprap, Sand Blankets, Vegetation Removal, Dirt Moving, Patios & Retaining Walls, Structures
- The Shoreland Stewardship Series: West, Paula, "Crow Wing County Landowner's Guide to Lake Stewardship". Minnesota DNR Shoreland Habitat Program, Crow Wing Soil and Water Conservation District, Crow Wing County Water Plan, Whitefish Area Property Owners Association, Thirty Lakes Watershed District, and Crow Wing County Lakes and Rivers Alliance.
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Appendix

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- John G. Cargill, IV, P.G. "Remediation & Restoration of Mirror Lake", Dover, Delaware. Battelle Conference on Remediation and Management of Contaminated Sediments. DNREC. January 13, 2015
- "Wisconsin Lakeshore Restoration Project Home Extension Lakes." UWSP, University of Wisconsin. Point, Stevens, 2008, www.uwsp.edu/cnr-ap/UWEXLakes/Pages/resources/WiLakeshoreRestorationProject/default.aspx.
- State of Minnesota, Crow Wing County. "Article 11: Shoreland District Standards" <https://www.crowwing.us/DocumentCenter/View/11694/Article-11-Shoreland-District?bidId>.
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- "On-Site Hydraulic Hose Replacement Service." PIRTEK USA, Pirtek Fluid Systems Pty. Ltd., 2 Dec. 2020, www.pirtekusa.com.



Design Studio Experience

2nd Year | 2017-18

LA 271 | Introduction to Landscape Architecture | Fall 2017 | Prof. Kathleen People
Tea House | Moorhead, MN

LA 272 | Parks & Open Spaces | Spring 2018 | Prof. Dominic Fischer
Old Broadway | Fargo, ND
Bison Park | Winnipeg, MB
Viking Park | Moorhead, MN

3rd Year | 2018-19

LA 371 | Site Planning & Design | Fall 2018 | Prof. Jay Kost
Steel Performance Center & Park | Fargo, ND
324 Plaza | Fargo, ND
Star City Plaza | Velva, ND

LA 372 | Community Planning & Design | Spring 2019 | Prof. Anna Maria
Amfissa Community Park | Amfissa, Greece
Fargo/Moorhead Community Theater | Moorhead, MN

4th Year | 2019-20

LA 471 | Urban Design | Fall 2019 | Prof. Dominic Fischer
Economical Landscape Design | Lower East Side, NY
Moorhead Crossing Design | Moorhead, MN

LA 472 | Environmental Remediation | Spring 2020 | Prof. Dominic Fischer
Estes Park Remastered Document | Estes Park, CO

5th Year | 2020-21

LA 771 Performance Based Design | Fall 2020 | Prof. Mathew Kirkwood
North County Trail | Duluth, MN
Red River Diversion | Argusville, ND

LA 772 | Performance Based Design Studio | Spring 2021 | Prof. Mathew Kirkwood
Lakeshore Design Intervention Thesis | Crow Wing County, MN



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About NDSU: "I can not be more thankful than I am today for the education that NDSU has provided. This program has helped me grow as a designer, and as a person. For whatever the future holds, my education has set me on a path to achieve every goal I have set out for myself."